also at Spring Glove.

STEPHAN GERSH

Voice 978.768.7822 Facsimile 978.768.3649 Email sgersh@cove.com

September 30, 2002

Dr. Craig D. MacDonald
Superintendent
Gerry E. Studds
Stellwagen Bank National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066

Dear Dr. MacDonald:

Thank you for this opportunity to submit my comments regarding the Stellwagen Management Plan Review. Having lived for the last 37 years in Essex, MA I have taken every opportunity to experience the diversity of marine life in the waters of the Sanctuary, before and after it's designation in 1992.

In particular my passion are the great whales, all of whom are currently classified as endangered species. I have been out on whale watching boats for as long as there has been whale watching out of Gloucester. To see them, hear them and smell their blow is to be exposed to magnificent creatures who evoke awe, humility and compassion. There is a presence in them that manifests the elemental force of life in all it's magic, strength and beauty. They bring us into a direct confrontation with wildness, so much needed in the antiseptic world we humans have created in the world for ourselves. Their environmental is one of the few not conditioned by human design. Whales bring me home and remind me that I and they together share in the great interdependency of life on this earth.

A sanctuary is a place of last resort where safety and protection at the highest level should be afforded to individual species as well as the ecosystem as a whole. Some human activities endanger whales and marine life and disrupt and destroy the ecosystems all marine life depends on for their existence. If we humans were not around if is obvious there would be no need to designate a sanctuary. The entire world, it's oceans and all it's species would live in a harmony resulting from evolutionary systems. We are the ones who disrupt these systems and as such we are the ones who are absolutely morally responsible to assure the least impact from our activities and assure that system the highest level of protection possible.

To see whales and other marine life in the Sanctuary, people travel by boats to and in the Sanctuary. They do so on commercial whale watching boats

One Conomo Point Road P.O. Box 949 Essex, Massachusetts 01929

as well as privately owned boats. Over the years the number of boats and the speed at which boats travel have increased tremendously. When I first ventured into the Sanctuary years ago I rarely saw a boat traveling more than 15 knots. Now I see high speed boats traveling at 40 knots. How on earth please tell me can you expect a boat at 40 knots to maintain enough control to avoid hitting a whale that surfaces without warning. Collisions between private boats and whale watching boat and whales and other marine mammals have increased over the years. Is this an indication that we have created a true sanctuary for marine mammals? I don't think so.

It's fine to issue whale watch guidelines, as NMFS did in 1999, but they 'suggest slowing down within two miles of whales to no more than 13 knots". Having been out on many many whale watching trips I have never seen this followed except by a very few whale watching boat captains In speaking with owners of private boars who use the Sanctuary I have never heard anything that indicates that they even know what the "suggested guidelines" require or even what they are. It is essential to change all whale watching guidelines to mandatory and enforceable regulation and extend the jurisdiction to all boats of any kind that are within the Sanctuary. It's the old argument about whether you allow the fox to hold the keys to the hen house and self-regulate their own activities.

No new research regarding this issue is needed. Use the data you currently have regarding specific areas where particular marine species are at risk and promulgate mandatory guidelines immediately. If humans, for example, were at risk from a contaminated food source that endangered our lives would we suggest that we conduct ongoing research to assess every detail of the potential impact and allow during the process additional people to be affected. I don't think so. We would respond overnight if we were the ones who were endangered. Why are marine mammals who are endangered by our behavior any different in their need for immediate protection as we would be if it we who were endangered.

Without public education and outreach the message will not get out regarding regulations regarding boat speed and approach protocols in the vicinity of whales. Marinas, boating clubs, docks, and town and city departments that issue mooring permits as well as the state registration requirements for boat ownership should all be targeted with education videos, presentations and printed information. I would even suggest that before any boater receives a mooring permit, registration number, or docking space they should be required to demonstrate their understanding of the responsibility they have when taking their boat into the Sanctuary.

Do we let anyone who feels like driving on our highways do so without a test to prove they know the rules of the road.?

Whale watch companies make their living by bringing people to the whales. The more time with the whales especially when the whales are performing display behavior such as lunge feeding or breaching the more excited and satisfied the customers are. Whale watching is about education in part but essentially it is a way to make money. If a captain can get to the whale first and stay on top of it for the longest time the better they serve their customers. I have been out on many whale watch trips and seen the whale watching boats racing, in excess of suggested speeds, to get to a whale, staying on top of it without exchanging times with other whale watch boat as is presently suggested and continue to track the animal at distances currently not recommended. Unfortunately this behavior is not always in the best interest of the whale.

Mandatory whale watching regulations should be applied to commercial whale watching boats as well as the private sector. I would further suggest that a license to operate within the Sanctuary be required of whale watch companies with the demonstrating that know and are willing to abide by the regulations. The license fee could be used to offset some of the costs of education and outreach. Please understands that there are responsible boat captains operating in the Sanctuary but I cannot say that all of the captains are as responsible as the few.

Regulations without enforcement are worthless. The Sanctuary does a poor job of enforcing even the present suggested guidelines. There needs to be a visible presence of patrol boats, especially during the height of the boating season. the The public as well as whale watch boat captains need to realize that the regulations for whale watching and the Sanctuary roles in general are to be taken seriously. Fines should be applied to those individuals who violate the regulations. Without the presents of police on our highways everyone would drive as whatever speed they felt like. Without enforcement all other discussions about protocols are a waste of everyone's time.

The continued entanglement of whales in fishing gear and marine debris continues even with the recent introduction of break away devises on nets and lobster trap lines. Not all entanglements necessarily occur in the Sanctuary, however there is still not enough information about those that do to define a more stringent policy and the techniques to prevent these entanglements. It is essential to develop accurate information dealing with this specific problem with the commitment to reducing entanglements to zero.

Protection of marine life cannot be separated from the habitat those species live in. If you don't protect the habitat you can't say that you are serious about the protection of the creatures who depend upon it. When the Sanctuary was originally designated it included the lower third of Jefrey's Ledge. This as you know is a similar area to Stellwagen extending northeast of Cape Ann to Southern Maine. There is of course a difference. The primary prey species on Stellwagen is sand lance and than on Jefrey's is herring. The two species seem to have a relationship. When one species is depressed in population numbers the other many times is abundant. Maine mammals feed on both and whales will go where there is food which many times is to Jeffrey's Ledge and not Stellwagen.

I would point out in particular this summer's remarkable occurrence of Blue Whales, not native to our waters, appearing on Jeffrey's Ledge to feed on herring.

Just as it was recognized that the Stellwagen Bank was located next to many highly developed urban population centers, Jeffrey's Ledge also shares this proximity to similar population centers along the coast of New Hampshire and Maine. Jeffrey's Ledge is subject to the same threats from human activities as is Stellwagen Bank. Jeffreye's Ledge however is not afforded the same level of protection as was afforded the original designated area of Stellwagen. In addition it is the most important spawning habitat for herring in the Gulf of Maine and overfishing can upset the balance in the ecosystem. The highly endangered northern right whale in particular depends on this area for feeding, especially in the fall months. The Whale Center of New England, who is represented on the advisory committee of Stellwagen Sanctuary, has supported for many years the extension of the Sanctuary to include the remaining two thirds of Jeffrey's Ledge. I cannot over emphasize the importance of this extension. In the oceans there are no fences that designated the northeast edge of Stellwagen. Stellwagen and Jeffrey's Ledge are contiguous and as such should be be recognized as providing similar resources to the marine mammals who inhabit and utilize them for their existence. Please take seriously the requests of many people to expand Stellwagen Sanctuary to include the whole of Jeffrey's Ledge.

Commercial fishing continues in Stellwagen Sanctuary and Jeffrey's Ledge. The most common type of fishing is trawling where nets are dragged across the sea floor. Many species of ground fish, such as flounder, cod and haddock are caught in this manner. The technique however disturbs the entire sea floor. It affects species diversity including plants and the very physical structure of the sea floor. It's like taking a vacuums cleaning and removing

everything in sight. What should be an obvious consequences of this practice are now being studied by the temporary closing of a region called 'the Western Gulf of Maine' by fishery managers.

The preliminary results indicate that when left alone the sea floor recovers with a large, diverse community of animals and plants. It's not too surprising to me since when we humans stop our assault on nature, nature in most cases is given a change to heal itself. In particular the closing of the Western Gulf of Maine as an important study area should not end. To open this area again to commercial fishing before we understand the total impact of commercial fishing on the health of the sea floor is foolish. Too many species depend on a healthy and naturally balanced ecosystem on the sea floor for their survival. Again without the continuation of this important study and allowing trawling to resume we base our decisions on short term rewards and sacrifice the essential knowledge of the long term consequences of what we do.

In closing I would like to refer to what I stated at the beginning of my comments. A sanctuary is a place of last resort where safety and protection at the highest level is afforded individual species as well as the ecosystem as a whole. I ask that the future Stellwagen Management Plan be based on the moral and scientific mandates required by a true Sanctuary. Thank you for allowing me to submit my comments to you.

Sincerely,

Stephan Gersh

Scoping comments attached,

Subject: E-Mail Sent To Craig
Date: Tue, 1 Oct 2002 12:36:31 -0400
From: Stephan Gersh <sgersh@cove.com>
To: sandi.dentino@noaa.gov

Dear Craig,

It was a pleasure to finally meet you last night in Gloucester. I look forward to working with you and Stellwagen Sanctuary on future projects as the Marine Exhibition Center unfolds at the Whale Center of New England.

I left last night's meeting very upset. I had spent four hours writing my comments letter. I wrote the letter as a private citizen, not as the President of the Whale Center of New England. I have mailed you a copy directly to your office. I explained to the moderator that I had drafted a five page comments letter and asked permission of her and the group at my table if I could simply read it. Everyone said yes. When I got three quarters of the way through she cut in and said because there were so many people wanting to give comments I had to stop before I finished my comments.

No one indicated there was a restricted length to the comments input. I care passionately about the issues being considered in the Management Plan and very carefully crafted my comments to reflect my many years involved with the WCNE as well as marine mammals in the Sanctuary. With the large number of people who showed up there should have been more tables and a greater number of moderators and recorders . Many of my comments were not recorded since I was asked to stop before I finished

I trust you will read my comments letter in full and include the comments on the specific issues I addressed. It did not feel right to me to be cut off regardless of the length of my letter. A lot of work and reflection went into it.

Cordially,

Stephan Gersh
WCNE
sgersh@cove.com

21 Joppa Rd.
Edinburgh
EH15 2HA
U.K.
4/10/02

Stellwagon Bank,
National Marine Sanct.
175 Edward Foster Rd.
Scituate, MA 02066

Dear Sirs

To protect the whales - marine life in your area, I think it is imperative that the protected area be extended as far as possible.

I believe there is an area called Jeffries ledge which could get with Stellwagon when providing feeding grounds for endangered species. I do hope you can help to care for these beautiful creatures

yours faithfully
Joyce Foley

May 24, 200[illegible]

To Whom It May Concern

in support

I am writing to you to support a speed limit within the sanctuary. People need to know we go in to animal space as just as well as they come into ours. When we own a pet we teach them things as well as they teach us stuff. We need to teach us stuff about the wild animals.

We were put here to share Earth with the animals not to take over and destroy everything.

So please work on a speed limit for the sanctuary. It is suppose to be a place for the

whales. I've adopted a humpback whale. I can't bring my humpback to my house and protect him like I do with the rest of my animals but I hope we can work together and protect the whales together.

We need to start making animals a priority we don't realize of we destroy animals that we are doing damage to ourselves as humans. Their was a balance and now there isn't we need to start working on putting the balance back.

yours truly,
Kallie Gabert

P.S.
SUPPORT B
SPEED LIMIT
SO WHALES
CAN LIVE!

13th September 2002

Att: Stellwagen Bank National Marine Sanctuary
Craig D MacDonald, Superintendent
Katrina Van Dine, Management Plan Coordinator
175, Edward Foster Road
Scituate,
MA 02066

Dear Craig & Katrina,

I am writing to you, as unfortunately I will be in England during the time that all of the intended scoping meetings will be held here between the 24th September and 5th October, so I will be unable to attend.

As an avid whale watcher and photographer for over 12 years, I have observed whales in four different oceans from over twenty different locations. I have participated in over 300 whale watch trips and have spent over 20 weeks in the company of whales from a private research boat. I financially support the Keiki Kohola Project run by Rachel Cartwright working with Humpback Mothers and Calves.(www.CaringForCalves.Com).

I would like to present the following for consideration under the review process.

With the formation of the Stellwagen Sanctuary (SNMS) a decision was taken to protect the marine life and the marine ecology within the designated area. By making that decision it also promotes to the world the special nature of the SNMS and it attracts visitors accordingly. Just in the same way that on land the designation of a National Park does. If you then as Managers and Custodians of the SNMS fail to protect the designated area, and the marine life that you have identified as being deserving of the special protection, by either supervision or regulation, then you are committing the greatest sin. You are bringing down upon the SNMS the intrusion of the human population, threatening the pattern of life that the marine life would have enjoyed, if you had not bestowed the protection in the first place.

Just as no one would expect to be allowed to drive their latest 4X4 SUV at speed around a Moose Mother and Calf pair in the heart of Yellowstone National Park, no one should expect to, or be allowed to harass a Humpback Whale Mother and Calf in the same way with a boat.

I have listed the following as a proposal to deal with a number of important issues, I hope you will take the time to consider them.

1) In order to form the basis of protection the SNMS needs to be able to raise funds for a number of reasons, to be able to both provide educational support and enforcement of the guidelines or regulations. To do this anyone wishing to use the Sanctuary area should be required to pay a Permit fee. These could range from US$25 per year for a small day fishing boat (0-30'), through $500.00 per year for commercial vessels and up to US$1,000.00 per year for Whale Watching vessels, whose business is all about being in the SNMS. Vessels transiting the SNMS could pay a fee, which could be set such that it does not harm the commercial competitiveness of Boston or any other harbor, for large commercial vessels this could be US$250.00 per year, and for smaller vessels $100.00. No one expects to pass through such areas without paying. Examples: National Parks, Toll Roads, Tunnel Tolls, Restricted Access Fees (City centers) Areas of special interest (Alpine Tolls).

2) For the fee paid each user would get a handbook containing the guidelines, rules and regulations of the SNMS, they also would get a highly visible orange disc with a number on it. This disc then allows either the US Coastguard or SNMS staff to identify individual vessels and trace back the persons responsible for the vessel.

3) The SNMS should be able to enforce fines for activities, which violate the guidelines, rules and regulations. I have witnessed appalling behavior by whale watch boats, which, whilst surrounded by private boats sends the wrong example to the private boaters. These kind of instances, should be subject to heavy penalties. All vessel operators need to know that if they do not follow guidelines there are consequences. I have seen local fishermen, lobstermen, private boaters drive through groups of whales at full speed completely ignoring their presence. This is not a sanctuary it is simply a free for all. The ultimate fine should be the removal of the permit to visit or operate within the Sanctuary.

4) One of the greatest debates of recent years is "speed". Just as on the road, speed kills, it also causes distress, and yet on the ocean, everyone runs away from the issue because it is too hard to enforce. This is not true, current technology provides a "track while you scan" radar system, that is capable of plotting the course and speed of up to 40 targets within a marked area storing all of the data and downloading this to a computer for record. A vessel, whether it be a Coast Guard vessel, a NMFS vessel or a SNMS vessel equipped with such a device, patrolling the sensitive areas, would put pay to the speeding issue very quickly. If "Mr Smith" average Boston private boater gets a call on his radio and is told he is doing 30 knots on a SSW course and he should not be, and if he does not slow down, he will be fined. The word would soon get around that the speed limits are enforceable. High Speed ferries should not be in sensitive waters.

5) The whale watch guidelines, which are currently being reviewed in the light of being made into regulations, are a major step forward but without enforcement, they will be meaningless.

6) All whale watch boats should have an independent Naturalist/Observer
All Naturalist should be qualified (NMFA or SNMS or NOAA)
There should be no after dark "cruises" if you can not see a whale how do you avoid one?
All night time ferries should be made to go around sensitive areas.

7) This brings us on to the "Use" of the SNMS, everyone understands that we do not want to lay oil pipes or gas pipes in the area, or go prospecting for other such industrial products, just as we would not expect the same thing in a National Park, but what we must focus on, is that in a Sanctuary, the only right of "use" belongs to the natural inhabitants, otherwise again it is not a sanctuary. One of the leading causes of concern presently with all whales, and in particular the Northern Right Whale is the question of entanglement. Lots of money has been spent on this issue, endless hours of discussions, new fishing gear proposals, but the whales are still getting entangled and are still being killed. Just take the nets and gear out of the water in sensitive areas. It is simple, this is either a protected place, or it is not, you cannot have one without the other. It is incredible to most common sense type of folk that there is such a "who-ha" about trying to save and endangered Northern Right Whale from drowning in tangled gear, when at the same time some fisherman is placing a new net in the very spot where the Whales like to feed. It would be akin to a poacher setting a trap for a rabbit, then the State spending money to try and save the rabbit after it has been caught. Recently when all of the media coverage was following the whale Churchill's attempted rescue, a 7 year old girl said to me, "this is like the story of the King with no Clothes just move the nets out of the whales way", what is obvious is in front of you but no one acts on it.

8) The SNMS should actively sponsor research programs to identify and answer many of the still un-answered questions surrounding the SNMS. What are the impacts of the changing fish populations and patterns, the distribution of vessels and types, the water quality, the impacts of new shoreline developments, the impact of sound on the marine life. Some of this is already being done, why for instance have the whales simply not been on Stellwagen this year?

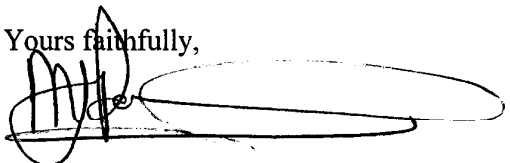
9) The new out reach centers are an excellent step in the education direction and should be expanded to include more exhibits and centers. Exhibitions about the dangers of Pollution, Dumping of Trash at Sea, a campaign to lessen the release of balloons along the coast, and much more can be done to involve the general public in understanding the part they play in keeping the environment as un-spoilt as we can.

From my experience of looking at the protection afforded to the Whales in particular, it appears that most of what we would want is on the "books" already, it is simply not being enforced. Only by in-acting an effective enforcement plan do you then provide the protection that we all want, it is more important than increasing the boundaries of the SNMS, because in some matters, being outside of this heavily trafficked area has it's advantages.

It is the behavior and consideration of people and vessels that create many of the problems for whales, with education these areas can be improved over time. With enforcement, education can be reinforced. I have had the joy of sitting on a small raft, having simply remained in one spot, for 3 or 4 hours and had whales come and check us out, coming to within inches of the side of the boat, similarly again sitting in one spot, I have witnessed a group of 8 Humpback whales use the bottom of the boat as a trap to catch the Herring who had taken refuge under the boat, placing us in the middle of a feeding lunge, entirely at the whales choice, direction and control, In both of these instances no intrusion into the Whales world was caused, because the behavior was appropriate.

I wish you well in your meetings, and thank you for your consideration of the above. I have attached for you a copy of my own, outreach work.

Yours faithfully,



Mark G Percival
16, Seaview Road, Gloucester MA01930-4268
mpercival@prodigy.net

Craig MacDonald, Superintendent
Gerry E. Studds / Stellwagen Bank
National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066

Dear Mr. MacDonald,

I support creation of fully protected areas within the Stellwagen Bank National Marine Sanctuary.

I am concerned about habitat destruction and excessive fishing pressure in Stellwagen Bank National Marine Sanctuary, and write to register my support for the creation of fully protected ocean wildlife and habitat areas through the Sanctuary's management plan review process.

Stellwagen Bank is a unique ocean ecosystem that sustains a rich diversity of marine life. Pollution, excessive fishing pressure, and damaging fishing practices threaten the well being of these distinctive creatures and critical habitats. Stellwagen Bank receives important protections as a national marine sanctuary; however, new measures are needed to help restore declining fisheries and preserve habitat.

Compelling scientific evidence supports the establishment of fully protected ocean wildlife and habitat areas as a way to address these problems. By leaving a portion of our coastal waters undisturbed, ocean wildlife and habitat areas can restore biological diversity and provide a safe haven for species now in decline. The resulting protected areas can also provide tangible, long-term benefits to fishermen. New England's economy and future depend on a healthy marine environment.

Please register my support for the creation of fully protected ocean wildlife and habitat areas within Stellwagen Bank National Marine Sanctuary.

Sincerely,

Richard Lerro

Richard Lerro
1318 Massachusetts Ave SE
Washington, DC 20003-1539

Marc Lerro

Ind 1

I am writing to express my support a speed limit for boaters in the Sanctuary. This should be a priority since Stellwagen Sanctuary was created largely as a haven for whales. Whales need all the help they can get from the growing problem of too many boats going too fast.

Stellwagen Bank National Marine Sanctuary

please support a speed limit within The Whaling Sanctuary. The Sanctuary was created largely as a haven for whales. That should be the priority of the Sanctuary mission.

Thank-You,

Shirley Kovar
1 S. 561 Yeden Dr.
Winfield, Il.
60190

Rabbits, Henry Carter • Art from Fine Art Photographs, London, England

Subject: [Fwd: [Fwd: [FWD: Fwd: NAVY SONAR MAY SILENCE THE OCEANS--Join us in supporting all marine life]]]
Date: Wed, 07 Aug 2002 09:14:06 -0400
From: "Craig MacDonald" <Craig.MacDonald@noaa.gov>
To: Kate VanDine <Kate.Vandine@noaa.gov>

Kate - Does this constitute a comment for MPR? Craig

Subject: [Fwd: [FWD: Fwd: NAVY SONAR MAY SILENCE THE OCEANS--Join us in supporting all marine life]]
Date: Tue, 06 Aug 2002 16:12:30 -0400
From: "Sandi Dentino" <Sandi.Dentino@noaa.gov>
Organization: OCRM
To: Craig MacDonald <Craig.MacDonald@noaa.gov>

From the web site...

-------- Original Message --------
Subject: [FWD: Fwd: NAVY SONAR MAY SILENCE THE OCEANS--Join us in supporting all marine life]
Resent-From: Stellwagen@noaa.gov
Date: Tue, 06 Aug 2002 15:07:28 -0400
From: <AuroraMaryKilai@netscape.net>
To: stellwagen@noaa.gov

Hello,

I recently participated in a whale watch out of Boston harbor with a group of youth from Hudson Montessori summer camp. Although we didn't see any whales that day, it was an enjoyable trip. Our guide was very knowledgable and shared a lot of interesting information with us. It's nice to know our marine life is being watched and cared for.
Thank you.

It is because of your dedication to marine life that I am writing you. You may already be aware of this Navy sonar program, but I thought I would bring it to your attention anyway (just in case you didn't know about it!)

I have already expressed my concerns to my senator and state representative. Please forward this to other people you know who may be concerned as well. The more our voices are heard, the better the chance there is to protect the whales, dolphins and other marine life.

Thank you.

Peace, Rev. Aurora Mary Kilai

Subject: Fwd: NAVY SONAR MAY SILENCE THE OCEANS--Join us in supporting all marine life
Date: Fri, 2 Aug 2002 12:04:03 EDT
From: Pollyapw@aol.com
To: Pollyapw@aol.com

This is mailed to the CCiA mailing list, hoping you will be inspired to act. Thanks.
Polly (Pat is away, will be back by the meeting next Thursday.)

Subject: NAVY SONAR MAY SILENCE THE OCEANS--Join us in supporting all marine life
Date: Fri, 2 Aug 2002 10:47:08 -0400
From: "Betsy Ritchie" <trilogy-has@worldnet.att.net>
To: "Polly Memhard" <pollyapw@aol.com>

Friends,

This is a wonderful opportunity to show your compassion and support for the world's oceans. Despite significant efforts by advocacy groups and concerned marine mammal scientists for the past several years, the government has approved the Navy's deployment of the Low Frequency Active Sonar (LFAS) in 80% of the world's oceans, effective **August 15, 2002**, for five years. The LFAS creates a powerful sound and pressure wave that can affect an area bigger than the size of Texas. The effective sound of the LFAS is roughly equivalent to being 20 feet away from a Saturn rocket at takeoff. For animals such as whales and dolphins whose lives depend on hearing, this is a potentially harmful and deadly concern. Other concerns include:

- Conclusive link of active sonar to strandings and deaths of whales.
- Evidence of significant disruption of communication, migration, breeding, and other behaviors of marine mammals.
- Documented dangers to divers and swimmers at levels less than the level the sonar is designed to operate.
- Approval by the National Marine Fisheries Service for the Navy to NOT comply with Federal environmental regulations such as the Marine Mammal Protection Act.
- Many unanswered questions and outstanding concerns that have not been adequately addressed in the documents the Navy prepared.

We are asking you to join in supporting our oceans and choosing compassion and love as ways of life rather than hate and fear. You can provide your support by (1) calling or sending the below sample letter to your representatives of Congress (click on the below links to get your state's representatives) and by (2) forwarding this e-mail to EVERYONE you know.

Thank you!
Betsy Ritchie
Cultural Creatives in Action

For more information on the LFAS and concerns of the impacts to marine wildlife, go to:
www.nrdc.org/wildlife/marine/nlfa.asp

To find your state senator(s) contact information, go to:
www.senate.gov/contacting/index.cfm

To find your state representative(s) contact information, go to:
www.house.gov/writerep/

SAMPLE LETTER

Dear ,

I am deeply concerned over the recent approval by the National Marine Fisheries Service (NMFS) of the U.S. Navy's plan to deploy the Low Frequency Active Sonar (LFAS) system, effective August 15, 2002, for five years. The Navy plans to use the LFAS in 80% of the planet's oceans, and poses a potentially significant and unacceptable risk to the marine mammals and other ocean life around the world. The intense level of noise that the LFAS generates travels far and fast in water, and is a particularly serious problem for marine animals such as whales and dolphins that have such exquisitely sensitive hearing and whose lives depend on their hearing.

Although the Navy prepared an Environmental Impact Statement (EIS) in accordance with environmental laws such as the National Environmental Policy Act (NEPA), other Federal environmental regulations are not being complied with. In particular, the Navy has been allowed an exemption from complying with the Marine Mammal Protection Act. This exemption allows the Navy to "take" marine mammals as a result of the deployment of the LFAS. In addition, the approval for the LFAS does not take into consideration the Endangered Species Act; there are a number of marine mammal species that are on the endangered species list.

There are many other concerns and unanswered questions about the short- and long-term impacts to the ocean's wildlife that have not been properly addressed in the EIS (January 2001), the Final Rule (July 16, 2002), or the Record of Decision (July 23, 2002). For example, there is evidence of adverse environmental impacts to various marine mammals (such as migration path changes, disruptions in communication and breeding, strandings, distressed behavior and panic, and deaths) from the Navy's testing of the LFAS and the mid-range sonar system now in use; these impacts have been inappropriately minimized. In addition, the potential risks to divers and swimmers are of concern (as documented by the Navy), but do not appear to have been adequately addressed in the documents.

Although the Navy believes that this system is essential for our country's security, I feel that national security MUST include a healthy global environment. There are other alternatives to the LFAS (if any are even needed at all!) that do not have such a negative impact to marine life. The major disruption that the LFAS could cause of the ocean's fragile and complex ecology--already weakened by overfishing, growing commercial traffic noise, and pollution--is unacceptable to me, and I wish to express my deep concern. I urge you to examine these questions SOON and support, with me, the ocean's precious wildlife and well-being.

Thank you for considering my views, and I look forward to hearing from you.

Peacefully,

Petition signed by 34 people (back of each letter)
asm

Monday, September 30, 2002

Management Plan Review Process Committee
Stellwagen Bank National Marine Sanctuary
175 Edward Foster Road
Scituate, MA 02066

Dear Superintendent,

I am concerned about habitat destruction and excessive fishing pressure in Stellwagen Bank National Marine Sanctuary, and write to register my support for the creation of fully protected ocean wildlife and habitat areas through the Sanctuary's management plan review process.

Stellwagen Bank is a unique ocean ecosystem that sustains a rich diversity of marine life. Pollution, excessive fishing pressure, and damaging fishing practices threaten the well being of distinctive creatures and critical habitats. Stellwagen Bank receives important protections as a national marine sanctuary; however, new measures are needed to help restore declining fisheries and preserve habitat.

Compelling scientific evidence supports the establishment of fully protected ocean wildlife and habitat areas where fishing and other extractive uses are prohibited as a way to address these problems. By leaving a portion of our coastal waters undisturbed, ocean wildlife and habitat areas can restore biological diversity and provide a safe haven for species now in decline. The resulting protected areas can also provide tangible, long-term benefits to fishermen. New England's economy and future depend on a healthy marine environment.

Please register my support for the creation of fully protected ocean wildlife and habitat areas within Stellwagen Bank National Marine Sanctuary.

Sincerely,

Students from Brandeis University

Students from Brandeis University

Name	Year
Robert Jackel	2004
[illegible] Cohen	2004
Kristen Stelljes	2003
Evan Paster	2004
Michael Hellman	2006
Rebecca G Horwitz	2005
Lee Tisman	2004
[illegible] Cottrell	2003
[illegible]	2005
Lawrence Stines-Strauss	2003
Marissa Green	2004
Leah Berkowitz	2003
[illegible]	2003
[illegible]	2006
Hillary Yaffe	2003
[illegible]	2004

Name	Year

Name	Year	Name	Year
Benjamin Fertig	2003		
Elana Klein	2003		
Michael Snodgrass	2006		
Elizabeth Tran	2006		
Sarah B. Wane	2004		
Jennifer Slocum	2006		
Valerie Cheng	2004		
Lauren M Pinaus	2003		
Joshua L. Weiger	2003		
Shoshana Stern	2003		
Phil Cedar	2003		
Adam Perlin	2003		
Greg Leppo	2003		
Aziz Nekoufar	'03		
Allyson Levine	2006		
Jacquen Cummings	2004		
Elina Vengel	2005		
Cheryl Levine	2003		

The Whale Center of New England

Formerly the Cetacean Research Unit

A NON-PROFIT ORGANIZATION EMPHASIZING WHALE RESEARCH, CONSERVATION AND EDUCATION

Kate Van Dine
Management Plan Review Coordinator
Stellwagen Bank National Marine Sanctuary
175 Edward Foster Road
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October 15, 2002

Dear Kate:

The Whale Center of New England is pleased that the Stellwagen Bank National Marine Sanctuary (SBNMS) is re-initiating their scoping phase of the Management Plan Review. We are pleased to address several issues that we would like to see the SBNMS consider as part of this review.

1) **Need for A Vision and Management Strategies**

The SBNMS has, since its dedication in 1993, never had a stated vision or end that it hopes to achieve. This has led to much confusion about what the Sanctuary should or should not be doing, and whether or not the actions it is taking are consistent with its long term goals. In order to make a revised management plan effective, we must first agree on a vision for the Sanctuary.

There is guidance in setting this vision that comes from the Marine Sanctuary Act itself. In Section 1431(b –Purposes and Policies)(6), the Act states that a National Marine Sanctuary is "to facilitate to the extent compatible *with the primary objective of resource protection*, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities" (emphasis added). The National Marine Sanctuary Program represents the only federal program, that I am aware of, that actively works to conserve ecosystems and biodiversity. Other agencies are heavily involved in single species management throughout the government, but no one has the freedom to have a vision for a conserved ecosystem like the SBNMS. We realize that there will be a number of pressures placed on SBNMS staff by industry voices with economic investment in the resources of the sanctuary, including (among others) whale watching companies, charter boat owners, and fishers. However, we strongly feel that despite this pressure, their needs should not be granted at the expense of the resources they are exploiting.

When creating a vision at this point, we are really starting from scratch. While we are aware that the current management regulations were handed down during congressional

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designation, we feel that they do not present a full compliment of restrictions that could lead to meaningful resource protection, nor do they address a coherent vision. The management plan review is a key time at which we can consider the goals of resource protection, the resources most in need of protection, and the suite of management activities that will get us to those goals. In essence, this is the first time we will have had the opportunity to create a vision for the Sanctuary.

Along with creating a coherent vision, effective resource management will be enhanced by setting out:

- long term management goals;
- steps necessary to achieve these stated goals; and
- evaluation criteria with which to measure progress is being made towards the stated goals.

2) **Boundary Considerations – Expansion of the boundary to include Jeffreys Ledge**

In the initial scoping meetings, we proposed a boundary expansion of the SBNMS to include the length of Jeffreys Ledge. Although time has passed, there has been little that would change the need and merit for protection of the full length of this important marine habitat.

When the Sanctuary was initially designated, the southeastern 1/3 of Jeffreys Ledge was included in the boundary, either as an afterthought or because it accidentally came below the line which connected the Massachusetts State Ocean Sanctuary and the area just north of Tillies Bank. As such, the Ledge is in the unusual situation of receiving official protection for a small part of its area, and the part that our data indicates is the least biologically important part for marine productivity and marine life.

While Jeffreys Ledge was clearly not the focus of the designation of the SBNMS, it meets all of the criteria for which Stellwagen Bank received official protection. It is an area of high topographical relief, which leads to upwelling and important marine productivity; it is an important feeding ground for marine mammals, sea birds, ground fish, and other marine predators; it is an important area for traditional fisheries, and because of its proximity to the well-developed coast of northeastern Massachusetts, New Hampshire, and southern Maine, it is vulnerable to human-induced habitat degradation.

In addition to these basic elements, there are several reasons why, in some ways, Jeffreys Ledge is a more important habitat for marine protection. Survey data collected from both trawls and, more recently, hydro-acoustic surveys indicate the Jeffreys Ledge is the single most important spawning habitat for the Gulf of Maine stock of herring (Clupea harengus). Herring are an important prey for marine mammals, including humpback, fin, and minke whales, Atlantic white-sided dolphins, Long finned pilot whales, and several pinnipeds, ground fish including cod and haddock, and predatory fish including blue fish, striped bass, and bluefin tuna. Combined with sand lance (Ammodytes spp.), they are the

primary baitfish upon which the Gulf of Maine ecosystem depends. In contrast, Stellwagen Bank is not a spawning area for herring or sand lance.

Jeffreys Ledge is also an important habitat for North Atlantic right whales, the most highly endangered of all whale species that occur in this ocean. Right whales have been an important component of SBNMS programs for many years, despite the fact that their presence within the boundary of the Sanctuary as it currently stands is uncommon. Recent published work done by our Center (reprint included) has indicated that Jeffreys Ledge may be a key fall feeding habitat for right whales. Hence, expansion of the boundary could allow additional protection for this species in an important part of their range.

Jeffreys Ledge also acts as a buffer zone in many years for many of the marine predators that use Stellwagen Bank. In numerous years when the cyclical sand lance populations have been low, many of the marine mammals and fish species that are often found on the Bank move to either Jeffreys Ledge or the Great South Channel. While the Channel is still a habitat based on sand lance prey, the Ledge represents a true buffer for the Stellwagen ecosystem. This has also been published in a peer-reviewed article, a copy of which is included.

In 1995, Stephen O'Leary (a Tufts University master's student), under the supervision of Brad Barr (former superintendent of the SBNMS) completed a "Policy Analysis of Management Options for Jeffreys Ledge." In his report (copy included), he considered three options for the Ledge: No protection, Boundary Extension, or Separate Designation. His conclusion was that Boundary Expansion was the preferred alternative of the three.

Currently, the SBNMS boundaries are arbitrary when compared with the natural system they are there to protect other than the inclusion of the length of Stellwagen Bank. Expanding the boundary to include Jeffreys Ledge would bring them into the realm of being biologically realistic and scientifically defensible. We would be glad to provide additional information on the arguments that support Sanctuary protection for this vital habitat. We urge the staff of the SBNMS to give this boundary expansion serious consideration.

3) **Speed restrictions to prevent marine mammal collisions in the Sanctuary**

Since the SBNMS was designated, there has been a major change in the way vessels transit the Bank itself and the Sanctuary overall. Vessel speeds have increased significantly, and there are now both mono-hulled and catamaran high-speed vessels that are used for both whale watching and passenger transit. Unfortunately, collisions between endangered whales and boats have increased during this period as well. In 1998, there were three collisions between whales and whale watching boats.

After these collisions took place, there were a series of meetings, which included SBNMS personnel, at which the whale watch guidelines were revised to better respond to concerns about speed and the risk of collision. All whale watch operators present at these

meetings agreed to abide by these guidelines. However, there has been little effective compliance in the field. We now regularly see vessels approaching whales at close range (less than ¼ mile) at high speeds, although they were supposed to slow to less than 13 knots at 2-mile range.

In addition to the risk from high-speed vessels, other vessel types represent risks of collision. Tuna fishermen often target areas where marine life, including whales, is present. These fishermen often transit close to whales with little regard for them, and several observers have seen numerous close calls. Recreational vessels also often transit through high use whale areas with little regard to collision risk, and there are numerous humpback and fin whales that bear scars from collisions with boats where scars are indicative of smaller propellers turning at high speed.

We feel that the SBNMS needs to address this risk, which is only likely to increase in the absence of proactive management actions. Since endangered marine mammals were identified in the original FEIS and management plan as an important resource of the sanctuary, such protection seems to fit well within the purview of management actions that would benefit important marine life.

While we feel that restrictions on vessel speed are important, we recognize and concur with industry concerns that there are many areas where whale occurrence is less likely to take place, and speed restrictions may be an undue burden. We are aware that an extensive review of whale distribution is being undertaken using the long-term databases of both our work and that of the Center for Coastal Studies. We suggest that the results of such a review be used to guide actions that are likely to benefit whales rather than placing such restrictions over a wide area with little regard to the extensive information that is available.

Finally, we also feel that there should not be discrimination among species of whales for protection. We have often heard that whale watch boats will not slow down as they pass by a little-regarded species, such as minke whales, in order to get to an area that is occupied by the larger humpback or fin whales that they target. However, the SBNMS is to protect all of these species, and the inconvenience to captains is not sufficient justification for putting these animals at risk.

As far as the actual management actions taken by the SBNMS, we do not at this point have a preference as to whether the approach of the current guidelines (placing zones around animals of known presence) is used, or restrictions are placed in areas of traditional high use regardless of whether or not a whale is known to be present. However, we do want to remind SBNMS staff that in only one of the cases of collision that we know of was the whale that was struck seen prior to the strike. Hence, management actions must account for the "unseen" whale that is, in fact, at greatest risk.

Finally, we also want to convey the necessity for whatever actions are taken be codified as regulation rather than an action which looks for voluntary compliance. Whale watch operators have shown again and again that they will not voluntarily comply with

inconvenient guidelines, despite putting whales at risk. SBNMS actions need to be regulatory and have sufficient enforcement to provide the protection that they intend (see below).

4) Require certification for any vessels engaged in whale watching in the sanctuary

Whale watching is one of the primary activities going on within the boundaries of the Sanctuary. There are whale-watching guidelines for the northeast region, but these are often not known or not followed. Boats often crowd whales, cause changes in behavior, such as interruption of feeding, or move too close to whales while in the Sanctuary. Many of these vessel operators do not understand "harassment" or how to identify when it is occurring. We need to guarantee that the whales are allowed to conduct their natural activities free of harassment, that the sanctuary is truly a "refuge" for these endangered animals.

Any vessel operator approaching whales for the purpose of watching should be well educated as to the safe operation of the vessel around whales. There are many factors in the safe movement of boats around whales. The guidelines for whale watching in the northeast region include no head-on approach, keeping a parallel course to whales, and no approaches closer than one hundred feet.

For this reason, we believe that any vessel operator within the Sanctuary should be required to go through training that will teach them how to properly operate their vessel around whales, and to understand something about the behavior and biology of the whales they are approaching. A refresher course for even the most experienced captains may reinforce the guidelines and may encourage captains to adhere to them. This training should be in the form of a class instructed by a marine mammal biologist. A certification to approach whales would be then be issued only to those operators who earned a minimum score.

Permitted vessel operators would have to display a visual signal (e.g. a flag, decal or other similar signage) demonstrating completion of the training and a passing score on the test. Only permitted vessel operators would be allowed to approach within 500 yards of whales for the purposes of whale watching. Sport and commercial fishers engaged in fishing would be exempt from the permitting requirement because their activities often places them within 500 yards of whales, but they presumably are not actively approaching whales. Further, we fell that if an operator is seen violating approach guidelines and/or regulations, their certification may be revoked for a set period of time and/or until they have been re-certified by the SBNMS.

While we ultimately agree that whale watching is an important use of the SBNMS, we also feel that this is an area where it is incumbent to insure minimal disturbance of the whales that the Sanctuary was designated, in part, to protect. Approaching an endangered species for personal enjoyment is not an inalienable right of boaters. While the tolerance of New England's whales to vessel approaches is well known, this certification will provide an additional insurance that whales are not disturbed in the Sanctuary.

5) Enact measures to protect aggregations of endangered whales in the SBNMS

While we noted above that there needs to be clarification about the suite of resources that the SBNMS was designated to protect, there can be little doubt that endangered humpback and fin whales were part of the impetus for the site's nomination in 1981. As such, it is reasonable to assume that management measures that would add protection for these endangered species as their populations recover would be consistent with SBNMS goals.

The long-standing problem of large whale entanglement in fixed fishing gear has been discussed extensively in the past six years. When the Marine Mammal Protection Act of 1972 was last reauthorized, it set up a series of "Take Reduction Teams" (TRT) to address the entanglement problem. One such team has addressed the problem in regard to large whales in the North Atlantic. Since the team's formation, numerous measures have been instituted including fishing gear modifications and both seasonal and dynamic area closures for highly endangered North Atlantic right whale aggregations.

Early in its deliberations, the Large Whale TRT made it clear that, because of the status and severity of the problem of entanglements and northern right whales, they were going to emphasize that species in their management actions, and hope that such actions would also benefit the other endangered whales they were tasked to address. While this is understandable given the immediacy of solving right whale entanglements, their limited presence in Sanctuary waters adds inadequate protection for humpback and fin whales.

We know that humpback whale entanglements take place in the SBNMS. In April, 1985, we witnessed a young humpback whale become entangled in a gill net on northern Stellwagen Bank. This observation was later published as a note in Marine Mammal Science (enclosed). In July 1990, we have reason to believe that three humpbacks were entangled within 2 weeks in the same location. In April, 1998, we again watched a humpback whale become entangled in a gill net on southern Stellwagen Bank. Hence, we know that there is a risk to these animals in the Sanctuary.

Given that we know that a risk of entanglement to humpback whales (and presumably fin whales) exists in the SBNMS, we feel that it is consistent with the purposes of the Sanctuary to take precautionary measures to minimize these risks in the Sanctuary. These measures could include, but may not be limited to, additional gear modifications to minimize risk, or limited area exclusions of certain types of fishery gear when aggregations of these species are located within a part of the SBNMS. The latter suggestion is based on the dynamic area management system NMFS has put in place on a wider scale to minimize risk in North Atlantic right whales, which we feel could easily be applied to the other species. If this were to be applied, we would suggest that the SBNMS should redefine what represents a sufficient aggregation of whales to trigger a management action, and over what area such a system should be implemented (concentrations should be higher than 3 in 75 square miles, and the area of risk may be more limited). The analysis that was conducted to determine the basis for the dynamic

closure system for right whales could easily be replicated with the sighting data the Sanctuary has obtained from both our group and the Center for Coastal Studies in their recent efforts.

Finally, we encourage the SBNMS to work with NMFS to continue to improve fishery gear modifications to minimize risk to whales. The Sanctuary could do this by funding additional work, encouraging fishermen to test new modifications in the SBNMS, or in other ways that increase the likelihood that fishermen and whales will be able to co-exist peacefully in the SBNMS.

6) **Insure remaining closure of the Western Gulf of Maine Fishery Closure area as a natural control to better determine the effects of bottom trawl fishing.**

For several years now, a rectangular area in the eastern portion of the SBNMS has been closed to ground fishing as result of management actions taken by the New England Fishery Management Council. While it was not intended to do so, one important effect of this action has been to set up a unique natural experiment about what happens to habitats within the area if they are not disturbed by traditional fishery operations.

Previous work that has been done by SBNMS staff, as well as other scientists, has started to come up with compelling evidence that areas that are heavily trawled can have extensive bottom damage. Sonar scans and underwater footage from underwater ROV's has shown that in portions of the sanctuary the bottom is covered with a series of crisscrossing tracks from repeat trawling. This level of activity may prevent organisms that depend on an undisturbed sea floor from inhabiting the area, and may greatly reduce the biodiversity of the habitat.

One of the important missions of a National Marine Sanctuary is to "to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes" (National Marine Sanctuary Act Section 1431(b)(3)), as well as to "to support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas" (National Marine Sanctuary Act Section 1431(b)(5)). For both of these reasons, it is critical that a portion of the Sanctuary be protected from detrimental fishery activity, so we can understand the effects of this activity for future management.

Although this area is currently closed to fisheries, as ground fish stocks recover the Fishery Management Council can at any time re-open that area. If this were to happen without consultation with SBNMS staff, irreplaceable information could be lost. In order to insure that this does not happen, we suggest that the Sanctuary work with the council in order to keep the area closed. Should this not be possible, we fell it is urgent for SBNMS staff to have the power in place to independently prevent activities which could destroy the protection the bottom has received. Finally, we suggest that the Sanctuary include monitoring of the bottom of this area be an annual research priority.

have taken place. While the threat of such actions can be important, it does not substitute for an active presence in the area.

Years ago, in a forum on whale watching put together by the Center for Coastal Studies, Capt. James Douglass of Cape Ann Whale Watch remarked that on his drive down to the forum, he had been going quickly until he passed a speed trap which he was able to see. He drove much more slowly after that, and used the analogy to the effectiveness of having an on-water enforcement presence. Law enforcement officers always say that they are effective if they either prosecute someone for committing a crime, or prevent a crime from happening because of their visible presence. The importance of this on-water presence by SBNMS enforcement agents cannot be over-emphasized.

We strongly encourage the SBNMS to make consistent on-site enforcement a cornerstone of the revised management plan.

8) **Increase Sanctuary Visibility**

The SBNMS has been lacking in visibility in the public eye. This is certainly understandable, as it starts with several strikes against it. The physical sanctuary itself does not start for several miles from the coast, and there is no on-water "signage" (as there would be for a terrestrial counterpart, like a National Park or National Wildlife Refuge). The headquarters of the Sanctuary is located far out on a bluff in Scituate, which is itself a remote and relatively little visited town. Since both the physical entity of the site and the headquarters are out of the public's path in many cases, it is easy for the Sanctuary to be ignored. In a recent study done for the Sanctuary, 80.8% of local residents who had not been whale watching had never heard of Stellwagen Bank, so we can only assume that at least that number did not know it was a National Marine Sanctuary. In order for the SBNMS to be really effective, its visibility needs to be increased.

In order to facilitate this, we feel that the Sanctuary needs to make better use of its partnerships with other agencies in more visible locations. The Visitor's Center that was established in Provincetown is an important start, but it needs to be just that – a start, not an end point. Similar sites need to be developed in both Boston and on the North Shore. Boston is critical because of the shear number of people who live and visit there, while the North Shore is key not only because of its number of residents and visitors, but also the high number of user groups (including whale watchers and fishers) who use ports like Gloucester and Salem to access the Sanctuary. Even in the existing display in Provincetown, the Visitor's Center needs higher visibility than it has currently been given.

Finally, the SBNMS can and should make good use out of partnerships with other agencies in order to maximize the effectiveness of their limited resources. This partnership should include other federal agencies, but should also include Non-

In the original management plan, as limited as it was, disturbance of the sea floor was one of the activities (excepting traditional fisheries) which was specifically prevented. Clearly the evidence that has come to light since indicates that there is an uneasy alliance between bottom trawling and the spirit behind this management restriction. If we are to be able to truly understand how to protect the biodiversity of the SBNMS, the information from this habitat control is absolutely critical.

As an aside to this measure, we also need a final clarification as to the role of the Sanctuary in fisheries management. Many people are under the impression that they were told that fisheries in the SBNMS were "never to be touched" during the initial designation process. Having been at those meetings, we know that this was not stated as strongly as commonly reported, but some assurances were implied. In order to make sure that everyone is clear on what the SBNMS may or may not do in terms of fishery management, a joint clarification issued by the regional Fishery Management Council, the National Marine Fisheries Service, and the SBNMS would go a long way towards clarifying this area in which there is much confusion.

7) **Effective Enforcement**

While an effective management plan is obviously critical to an effectively managed Sanctuary, the best management plan means little without effective on-water enforcement from the Sanctuary. This enforcement needs to be directed specifically at making sure that sanctuary management actions are adhered to, and cannot effectively be combined with the priorities inherent in agreements with other agencies.

The need for effective enforcement has made itself clear over the past several years. Whale watch companies have shown repeatedly that without regulations and consistent enforcement, they will ignore restrictions that they themselves have agreed to. We know that fishers will deliberately not report marine mammals for fear of the consequences of their known abundance (i.e. temporary fishery restrictions through the Dynamic Area Management System of the National Marine Fisheries Service). In many cases, private boaters are not aware of the management actions or restriction in the Sanctuary (meaning an educational component, such as the "See A Spout, Watch Out" campaign, is vital as well).

We also know that the SBNMS has, in the past, used inter-agency agreements with the U.S. Coast Guard and the Massachusetts Department of Fish and wildlife Office of Environmental Law Enforcement in order to carry out their on-water enforcement. This has had limited success. Often these agencies have had other priorities or commitments that have prevented them from being the consistent on-water presence they need to be. The times they have been present have demonstrated, to me, that compliance really increases from all user groups.

The presence of an enforcement agent to deal with Sanctuary issues, added in recent years, has been a good start. However, his enforcement only can work on violations that

governmental partners, such as has been done with the Center for Coastal Studies on the South Shore and the New England Aquarium in Boston. We would also emphasize the importance of increased visibility on the North Shore, especially in Gloucester. Many users of the Sanctuary are found in this coastal town, and both interest and paranoia runs high (as witnessed by the large turnout, much of which was from the fishing community, at the Scoping Meeting in Gloucester on September 30, 2002).

9) **Prioritize living marine resources over historical cultural resources in future work**

In the summer of 2002, the finding of the remains of the ferry *Portland* made headlines around the country. This announcement has led to an enthusiasm for continued exploration of other historical resources, including other wrecks, which may be present in the Sanctuary.

We agree that the exploration of other potential wreck targets in and around the Sanctuary is intriguing, we feel that there are a host of other institutions in the area that are equally likely to do a satisfactory job of exploring these. The SBNMS has limited resources, and those resources need to be used carefully in order to carry out the Sanctuary's work. There are few other groups that are charged with protecting the marine resources as the SBNMS is, and we feel that the maximal amount of resources needs to be devoted to this end. This is especially true if the items we list above (increased enforcement of new provisions to limit speeds, have a no-trawl zone, and to extend the Sanctuary's boundaries) are put into place.

We thank you again for the opportunity to provide input into the early stages of the management plan review, and look forward to continuing to work with you throughout the process.

Sincerely,

Mason Weinrich
Executive Director

agencies in order to maximize the effectiveness of their limited resources. This partnership should include other federal agencies, but should also include Non-

MARINE MAMMAL SCIENCE, 16(2):326–337 (April 2000)

RIGHT WHALES (*EUBALAENA GLACIALIS*) ON JEFFREYS LEDGE: A HABITAT OF UNRECOGNIZED IMPORTANCE?

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ABSTRACT

North Atlantic right whales (*Eubalaena glacialis*) are known to spend the majority of the year between the Great South Channel southeast of Cape Cod, and the Nova Scotian shelf. We examined sightings of right whales on and around Jeffreys Ledge, a 54-km-long glacial deposit off the coast of northern Massachusetts, New Hampshire, and Maine. Sightings on Jeffreys Ledge were extracted from three data sets: (1) a systematic survey of the entire northeastern continental shelf between 1979 and 1982, (2) whale-watch and research-cruise sighting data from 1984 to 1997, and (3) a collaborative database of sightings collected by organizations conducting right whale research and all other available sources. Each database supported two seasonal sighting peaks. During summer (especially July and August) sightings were primarily of mother-calf pairs. Several cow-calf pairs were seen over several days to weeks. Several females were resighted in more than one year, but only when calves were present. During October, November, and December, sightings included all age classes, surface-feeding behavior was frequently observed, and some animals were resighted over several weeks. Given the relatively reduced sighting effort during fall, this number of sightings is surprising. During the 20 yr of observations, 52 of 374 photo-identified North Atlantic right whales (13.9%) were seen at least once on Jeffreys Ledge. We suggest that Jeffreys Ledge may be a more important right whale habitat than previously believed, and that it may play an important role in annual movements and distribution of this population.

Key words: right whale, *Eubalaena glacialis*, Jeffreys Ledge, whale migration, whale distribution.

The northern right whale (*Eubalaena glacialis*) is the world's most endangered large whale species. Some 300–350 animals currently live in the western North Atlantic Ocean (Knowlton *et al.* 1994), and remnant populations persist in the North Pacific (Scarff 1986). This species was hunted extensively until the early part of the 20th century but has been protected from commercial whaling officially since 1935 (Brownell *et al.* 1986).

In the past two decades, intensive surveys in certain high-use habitats have revealed a basic annual pattern of movements of the North Atlantic population (Winn *et al.* 1986, Kraus and Kenney 1991). During winter, a portion of the population (primarily mothers with newborn calves, and some juveniles) occurs off the coast of the southeastern U.S. During late winter, these whales move northward and join other right whales, first in Cape Cod Bay and, shortly after, in the Great South Channel (between Cape Cod and Georges Bank) (Hamilton and Mayo 1990, Kenney *et al.* 1995). From there, many animals move north to the Bay of Fundy and the Nova Scotian shelf for the summer, remaining until at least early autumn (Mitchell *et al.* 1986, Kraus *et al.* 1988, Murison and Gaskin 1989, Gaskin 1991).

Between the early fall disappearance of right whales from the Bay of Fundy and winter occurrence of calving females and juveniles off the southern U.S. and late winter appearance of all segments of the population in Cape Cod Bay, little is known of their distribution and almost nothing is known of their movements.

While the distribution and occurrence of right whales is well documented in high-use habitats such as the southeastern U.S. (Kraus *et al.* 1988, Kraus and Kenney 1991), the Great South Channel (Kenney *et al.* 1995), Cape Cod Bay (Hamilton and Mayo 1990, Kraus and Kenney 1991), and the Bay of Fundy and Scotian shelf (Mitchell *et al.* 1986, Kraus *et al.* 1988, Murison and Gaskin 1989, Gaskin 1991), little is known outside those areas. Survey and other research effort has been highly biased towards areas of known use. In this paper we examine sighting records of right whales on and around Jeffreys Ledge, an underwater shoal located off the New England (especially New Hampshire and Maine) coastline, which has not been previously identified as an important habitat for northern right whales.

Methods

Jeffreys Ledge is a complex, shallow glacial deposit, characterized by depths of 45–61 m and a length of approximately 54 km (Fig. 1). Depths of 85–120 m occur on the west side of the Ledge ("Scantum's Basin") and 100–150 m to the east. Bottom substrate is a mixture of rocks, sand and gravel, and mud, both on the Ledge itself and in the deeper basins. We defined the Jeffreys Ledge "region" for sightings data as lying between 43°20′N and 42°35′N, and west of 69°50′W to the shoreline.

Sighting data for this paper were collected from three programs: (1) a comprehensive cetacean survey program conducted off the northeastern United States (1979–1981), (2) commercial whale watch (1982–1996) and dedicated

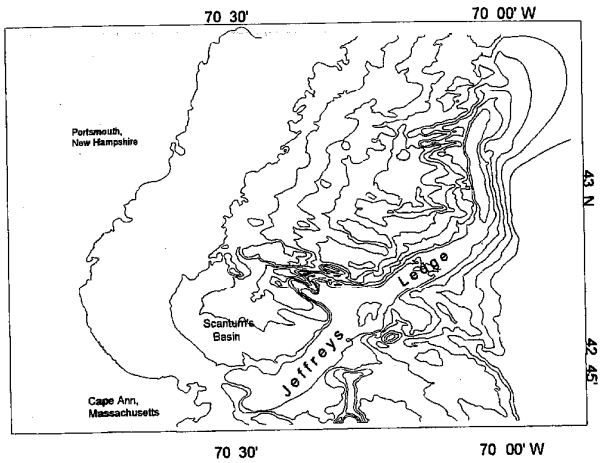

Figure 1. Bathymetric contour plot of Jeffreys Ledge area.

vessel coverage (1984–1997); and (3) a comprehensive database of all reported sightings of North Atlantic right whales from any available source through 1994. Details of these programs are as follows:

(1) The Cetacean and Turtle Assessment Program (CETAP) was conducted by the University of Rhode Island (URI) from late 1978 through early 1982 for the continental shelf of the United States from Cape Hatteras to Nova Scotia (CETAP 1982). It included dedicated surveys from air and shipboard, a platforms-of-opportunity (POP) survey program in which trained observers were placed aboard a wide variety of aircraft and ships working in the study area, and collection of opportunistic sightings from all available sources, including historical data which existed prior to the study. CETAP data are archived at URI (see below). Trackline and environmental information included with the dedicated and POP survey data can be used to quantify survey effort as length of survey trackline completed within defined criteria (observers on watch, sea state of Beaufort 3 or below, visibility at least two nautical miles, and aircraft altitude 305 m or lower). For details of the CETAP surveys or the SPUE methods, see CETAP (1982), Kenney and Winn (1986), and Shoop and Kenney (1992).

(2) The Cetacean Research Unit (CRU) in Gloucester, Massachusetts, collected right whale sighting data from commercial whale watches between 1984 and 1996. Whale-watch vessels working out of Gloucester were used exclusively from 1984 to 1991, covering only the southern half of Jeffreys Ledge. In 1992 CRU instituted a sighting network of whale-watch boats from a number of ports in New Hampshire and southern Maine, which covered all of the Ledge regularly. Whale watches typically allowed two hours on or around the Ledge. Whale-watch cruises took place from May until October, with a heavy emphasis on the months of June through September. Whale

watches usually targeted areas where humpback whales were most common (see Weinrich *et al.* 1997 for additional details on whale-watch methodology).

Dedicated-vessel coverage by CRU took place aboard a 6.7-m vessel (1984–1992) or an 8.3-m vessel (1993–1997) departing from Gloucester, Massachusetts. Each cruise was 7–13 h long. These excursions took place from 1 April to 15 November in each year, with emphasis on work in April, October–November, and during opportunistic periods of reported whale concentration during May to September.

(3) Since 1986 a number of research groups and institutions have joined in a cooperative program, informally called the right whale "consortium." One aspect of the program is data sharing, with all sighting data being incorporated into a common database (the "consortium database"), which is managed and archived at URI. The original core of the database was the CETAP data. A copy of the photo-identification database from a right whale catalog is also maintained at URI, and the two databases are cross-referenced. Both the consortium and catalog databases include contributions from a wide variety of sources and so are the broadest available record of right whale occurrence in the western North Atlantic. Because of the varied nature of the data, it was impossible to quantify effort. However, all records for the Jeffreys Ledge area were extracted and summarized for analysis.

It should be noted that the three data sources utilized in this paper are not independent. At least some occurrences of right whales in the Jeffreys Ledge area are recorded in more than one. For example, when a right whale was sighted by CRU observers and photographed, the photos are contributed to NEA and incorporated into the catalog, and all catalog records not already included in the consortium database are added during annual updates. Wherever possible, we separated overlapping data by comparing sighting lists for duplication by day, location, or observer.

Individual right whales were identified through photography (usually using 35-mm cameras and 200–400-mm maximal focal length zoom lenses) of the callosities on the whale's head and additional scars or distinctive markings (Kraus *et al.* 1986). Photographs were matched against a collaborative catalog maintained at the New England Aquarium (NEA) (Kraus *et al.* 1986, Crone and Kraus 1990), and assigned numbers accordingly (listed as RWC (Right Whale Catalog) #). Life history details reported here originate from previous sighting information detailed in the catalog.

Results

CETAP Data

There were 13 sightings of 22 right whales on Jeffreys Ledge during the CETAP surveys (Table 1). Of these, 11 (84.6%) sightings of 18 (81.8%) whales were between October and December, during 35% of the total Jeffreys Ledge survey effort. December had both the greatest number of sightings (9) and the greatest number of individuals (15), all seen on 7 December 1978 (Fig.

Table 1. Effort and sightings data for right whales on Jeffreys Ledge from each of three data sets. Because the different data sets were not directly comparable, different summary variables are used for each.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Cetap data													
Survey hours	11.4	460	417	489	137.2	618.1	340.6	490.4	303.2	382.9	797.7	568.9	5,016
Sightings	0	0	0	0	0	1	1	0	0	1	1	9	13
Individuals	0	0	0	0	0	1	3	0	0	1	2	15	22
Cow/calf pairs	0	0	0	0	0	0	0	0	0	0	1	0	1
CRU data													
Vessel days	0	0	0	23	69	151	249	234	174	108	0	0	1,008
Sightings	0	0	0	2	0	0	7	8	13	13	0	0	43
Individuals	0	0	0	2	0	0	9	9	19	27	0	0	66
Cow/calf pairs	0	0	0	1	0	0	2	2	0	4	0	0	9
Consortium data													
Sightings	3	0	3	8	13	4	83	34	21	34	11	17	231
Individuals	3	0	7	13	19	5	103	69	31	50	22	26	348
Cow/calf pairs	0	0	0	1	3	1	18	14	5	2	1	0	45
Catalog records	0	0	0	0	3	1	44	15	17	17	1	2	101
Different animals ID'd	0	0	0	0	3	1	21	12	12	16	1	2	52*
Cow/calf pairs ID'd	0	0	0	0	2	0	20	5	3	2	0	0	33

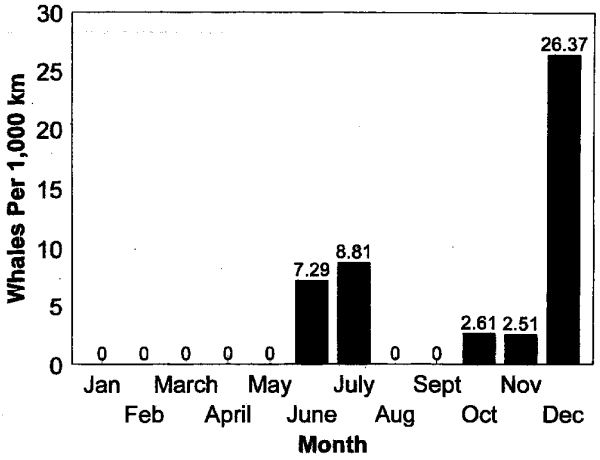

Figure 2. Sightings of right whales per 1,000 km for CETAP database, 1978–1981.

2). Survey effort was greatest in June, November, and December, with substantial coverage in all months except January and May (Table 1). Only one cow/calf pair was seen (in November) during the CETAP surveys.

CRU Data

There were 43 sightings of 66 individuals on Jeffreys Ledge (Table 1). Of these, 34 (79.0%) sightings of 55 (87.3%) individuals were seen between August and October. September and October had the greatest number of sightings (13 in each month), with more individuals (27) being seen in October than in any other single month (Fig. 3). By comparison, survey effort was greatest during July and August (when 47.9% of total survey effort took place), with secondary peaks in June and September (Table 1). The single highest daily count was seven whales photographed on 31 October 1994. Nine of the 43 (20.9%) sightings were of cow/calf pairs: one (11.1%) in April, two (22.2%) in July, two (22.2%) in August, and four (44.5%) in October.

Consortium Database

There were 231 sightings of 348 whales on Jeffreys Ledge between 1972 and 1994 (Table 1). Whales were seen in all months except February. More whales were seen in July than any other month, when 103 (29.6%) animals were recorded. Other months with high totals were August (69 individuals, or 19.8%), and October (50 individuals, or 14.3%). Between 22 and 31 whales also were seen in each of September, November, and December. In total, 301 whales were seen between July and December, while there were only 47 animals between January and May. Cow/calf pairs were seen on 45 occasions, of

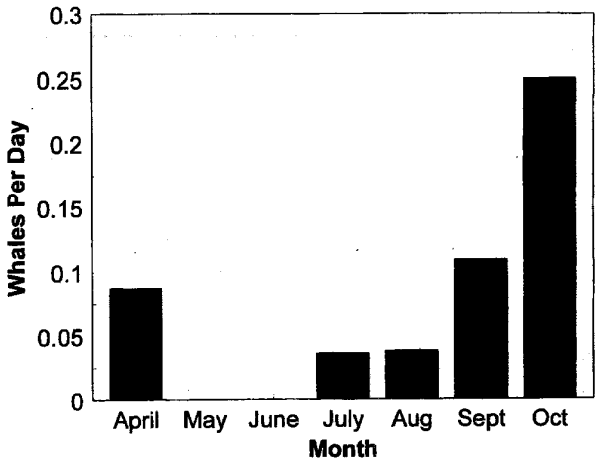

Figure 3. Sightings of right whales per day, CRU database 1984–1997.

which 32 (71.1%) were seen during July and August, and only 8 (17.7%) during September through December.

In total, there are 101 catalog records from Jeffreys Ledge (0.93% of the total 10,833 catalog records) of 52 different individuals, or 13.9% of the 374 photographed whales. Out of the twenty cow/calf catalog records from Jeffreys Ledge in July, 18 (90%) were of only five females. Several whales were resighted on Jeffreys Ledge both within the same year and between years. RWC #1266 was photographed on eight occasions in three years: twice in July 1982, five times in July and August 1985, and once in July 1988 (all years in which she had a calf). RWC #1152 (a male) was seen on Jeffreys Ledge on five occasions in October 1983 and September 1984. RWC #1505 (then a 9-yr old male) was seen on 10, 11, and 18 September 1994. A mother-calf pair (RWC #1412 and #1413) were photographed on Jeffreys Ledge on 6 October and 21 October 1984, a 15-day sighting interval. This female was rephotographed with a different calf on 4 and 5 October 1997; no other sightings of this whale exist in the catalog, either from the calving grounds or any of the other known high-use areas.

Discussion

The sighting data from all three sources suggest that Jeffreys Ledge may be a more important habitat for right whales, both in terms of numbers of animals and consistency of occurrence, than has been previously recognized. The area appears to be one where right whales are seen on a regular basis, especially when animals may be moving to and from more northern waters. Furthermore, the records from Jeffreys Ledge represent the greatest number of sightings during the fall, when the movements of right whales are poorly known.

The highest number of right whale sightings in the consortium database for Jeffreys Ledge was during July and August (49.8% of total sightings). This is a period when most, if not all, animals have departed the Great South Channel (Kenney *et al.* 1995) and are arriving in the Bay of Fundy (Winn *et al.* 1986, Kraus and Kenney 1991). Except for mother-calf pairs, whales apparently remained on the Ledge for only short periods of time. This suggests that many of the Jeffreys Ledge sightings were of transient whales moving toward the Bay of Fundy and the Scotian Shelf, which lies approximately 200 km to the northeast of Jeffreys Ledge. There may be little energetic advantage to remaining for extended periods in the Jeffreys Ledge area during the summer, given the high probability that richer prey resources are available in the Nova Scotian feeding grounds.

Mother-calf pairs were disproportionately represented on the Ledge during this time. This is not unexpected since right whale mother-calf pairs are sighted in many areas throughout the Gulf of Maine during the late spring and early summer.[1] It is possible that mothers may also be exposing their calves to "traditional" feeding habitats at this time and may be bringing their calves to Jeffreys Ledge for this reason. Radio-tagging studies have shown that mother-calf pairs traverse unusually large distances when compared to other classes of whales (Mate *et al.* 1997), and studies of humpback whales have shown that calves are more likely to return to a specific location if they were first sighted there as calves (Weinrich 1998). Certainly this is supported by animals such as #1266 and #1412, who have each been seen on multiple occasions in multiple years when they had a calf, but not in intervening years.

Perhaps more surprising is the number and consistency of sightings of right whales on Jeffreys Ledge during the fall. This is a period where observer effort is at its lowest, especially in the CRU database. Whale-watching boats all terminate their season by the end of October for insurance reasons and greatly reduce their number of trips after the start of September. One would therefore expect a strong bias towards summer sightings. Despite this, September and October were the months at which sightings peaked in the CRU data. CETAP data show a similar peak, much of which can be attributable to a cluster of nine sightings of 15 whales on a single December day. This shows that large concentrations of whales have occurred at times when coverage in other areas may have not recorded them at all.

It is striking that in the fall we do not see the disproportionate number of mother-calf pairs that we do during summer sightings, as evidenced in both the CRU and consortium database. Calves may be weaned and separated from their mother by this time. In humpback whales weaning occurs as early as mid-October in a few mother-calf pairs (Baraff and Weinrich 1993), and right whale calves can survive weaning by this time (Hamilton *et al.* 1996). However, we believe it is unlikely that weaning alone would account for the lower proportion of cow-calf pairs. Rather, this may simply be an important feeding

[1] Personal communication from Scott Kraus, New England Aquarium, Central Wharf, Boston, MA 02110, January 1998.

area for the population as a whole following their departure from the Bay of Fundy, with the number of mother-calf pairs representative of the population as a whole. During the summer most right whales are passing through en route towards rich feeding grounds in the Bay of Fundy/Scotian Shelf area, while mothers with calves are lingering for longer periods.

Jeffreys Ledge may also be an important feeding habitat for right whales during the fall. Surface skimming and apparent near-surface feeding (whale leaving slicks constantly on the surface while spending prolonged periods of time (up to several hours) in areas less than 1 km diameter) were commonly seen during fall sightings. Typically during July and August whales were observed traveling, and we have no observations of surface-feeding behavior. The low level of observer coverage and photo-identification effort would greatly underestimate length of stay during the fall period, but our data show several individuals (including the only residency of any animals besides cow/calf pairs) who were resighted for at least a week within the same year.

Further evidence for prolonged occupation of Jeffreys Ledge in the fall comes from satellite tagging data (Mate *et al.* 1992, 1997). An adult male right whale tagged in the Bay of Fundy on 15 October 1989 left the Bay shortly after being tagged and then spent at least 10 d on or near Jeffreys Ledge (25 October–5 November 1989). Tag transmissions ceased while the whale was still around the Ledge, so this was a minimum occupancy period.

We assume that right whales remain in the Bay of Fundy as long as prey is sufficient. Once prey availability falls below a certain level, however, the whales will likely abandon that area and may begin a migration toward their winter habitats, either the southeastern United States coast (especially for pregnant females and juveniles) or other destinations still unknown. If this movement is, in fact, triggered by lack of prey and there is another area nearby where prey resources may be sufficient, the whales may at least investigate that region briefly on their way out of the Gulf of Maine. If right whales feed little, or even fast completely for prolonged periods during the winter, it would make adaptive sense for them to stay in that area as long as prey resources remain sufficient.

All of the known high-use feeding areas for right whales have geological features which appear to favor concentration of plankton, especially calanoid copepods, through interactions with hydrographic conditions (Mayo and Marx 1990, Kraus and Kenney 1991, Kenney *et al.* 1995). The topography of Jeffreys Ledge, and the counter-clockwise current throughout the Gulf of Maine influences the oceanography of the Ledge (Apollonio 1979), placing this area in the same broad category.

We do not know on what prey right whales feed while on Jeffreys Ledge. In other habitats North Atlantic right whales feed primarily on copepods, especially *Calanus finmarchicus* (Kenney *et al.* 1985, 1986; Murison and Gaskin 1989; Kenney and Wishner 1995), with some variation when other species are abundant (including *Pseudocalanus minutus, Centropages* spp., or larval barnacles; Mayo and Marx 1990). Copepod productivity in the Gulf of Maine is highest in spring and decreases during summer and fall (Apollonio 1979), so

the time that right whales are on Jeffreys Ledge should be that of lowest copepod availability. It is possible that the oceanographic features of Jeffreys Ledge aggregate available copepods into levels which attracts right whales. There is, however, an alternate source of prey which right whales may also use which is uniquely present on Jeffreys Ledge during this time. During the fall, Jeffreys Ledge is the largest spawning ground for the Gulf of Maine herring (*Clupea harengus*) stock (Boyar *et al.* 1973, Cooper *et al.* 1975, Sinclair and Tremblay 1984). Herring eggs hatch into 5–7-mm planktonic larvae after 1–3 wk, grow approximately 2 mm/mo until the following spring, and are generally retained within the area of hatching for at least several months (Iles and Sinclair 1982, Townshend *et al.* 1989). While there are no records of herring larvae density which approach the levels of 1,000/m^3 found as a feeding threshold by Mayo and Marx (1990), few actual measurements have been made.[2] Our understanding of the feeding ecology of right whales on Jeffreys Ledge, therefore, might benefit from more intensive studies of habitat use and prey.

Jeffreys Ledge may be an important fall feeding area for right whales and an important nursery area during summer. The presence of considerable concentrations of whales during fall, sighted over several years despite very low observer effort, and the indication of some extended whale residencies appears to indicate a habitat which plays an important role in the annual cycle of this population. More dedicated surveys during the fall and early winter and studies of the physical and oceanographic characteristics of the area itself would provide more insight into the importance of Jeffreys Ledge as habitat for right whales in the Western North Atlantic.

Acknowledgments

We thank numerous Cetacean Research Unit staff and interns over the years who have helped collect this information, especially Cindy Belt, Mark Cappellino, Rachel Griffiths, Malcolm Martin, and Mark Schilling; members of the Jeffreys Ledge Sighting Network, including Leo Axtin, Dane Badders, Jenny Bove, Jon Gwalthney, Jen Hafner, Nancy Miller, Elizabeth Phinney, Diana Schulte, and others; Scott Mercer for his contributions to the consortium database; and Marty Crone, Amy Knowlton, and Scott Kraus who aided in photographic matching at the New England Aquarium. Phil Clapham and an anonymous reviewer made many constructive criticisms of the manuscript. Portions of this work were conducted under Marine Mammal and Endangered Species Research Permits #681 and #959 issued to the Cetacean Research Unit.

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Received: 24 March 1998
Accepted: 30 August 1999

MARINE MAMMAL SCIENCE, 15(2):559–563 (April 1999)

BEHAVIOR OF A HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*) UPON ENTANGLEMENT IN A GILL NET

Entangled baleen whales have been observed swimming with gear on them, and have been found dead with either fishing gear or scars on them which suggest that entanglement may have been a factor contributing to their mortality (Hare and Mead 1987, Heyning and Lewis 1990, Mazzuca *et al.* 1998). Scars observed to be created from entanglements have been used to infer entanglement rates (Kraus 1990, Kenney and Kraus 1993) which, along with direct observations of carcasses in gear, have led to the belief that fishing gear entanglements are one of the most significant threats to whales today (Perrin *et al.* 1994). In Newfoundland, Canada, humpback whale entrapments in cod fishing traps have been a major management issue since the mid-1970s (Perkins and Beamish 1979, Lien 1989). Little is known, however, about the functional nature of entanglements of whales: how and when whales entangle, in what type of fishing gear they entangle, and whether the gear is actively fishing or has been lost at sea ("ghost gear"). Lien *et al.* (1990) indicated that entanglements in Newfoundland cod traps were more likely to happen at night and were more likely within 24 h of initially setting the fishing gear.

On 15 April 1986 three observers from the Cetacean Research Unit undertook a day-long photoidentification survey of humpback whales on northern Stellwagen Bank, some 21 km southeast of Gloucester, Massachusetts, aboard a 6.7-m research vessel. Approximately 30–40 humpback whales were in an area of approximately two square nautical miles. Many of the whales appeared in an active state, with generally short (one- to three-minute) dives, two to four respirations per surfacing, and rapid swimming, although component movement was minimal. Their behavior, combined with apparent bait traces detected in the lower portion of the 50–55 m water column on our 50 kHz echosounder, led us to believe the whales were feeding below the surface. Occasional aerial behaviors (breaching, lob-tailing, and flippering) were observed sporadically in the area, although not from our focal animals. Sea conditions were calm with a swell of less than 1 m and no wind. Numerous "high-flyers" (surface markers for bottom-set gill nets) were in the area.

At 1638 we approached and initiated observations on a juvenile humpback, later matched to a whale first photographed as a calf in May 1985 on Stellwagen Bank (referred to as whale # 603). After a dive of 120 sec it calmly surfaced approximately 50 m away from our vessel. While initially photographing its dorsal fin and tail flukes from 25 to 30 m, we saw no fishing gear on the animal.

The first observed surfacing was followed by a dive of 153 sec. When the whale reappeared, it initially surged to the surface at an oblique angle, clearing the water to its flippers and landing with a chin slap. It immediately started rolling 360 degrees and became increasingly agitated. In the two minutes

following surfacing, the whale rolled seven times, trumpeted (creating a loud wheezing sound audible above the surface during exhalation; Watkins 1967) four times, and belly-up lobtailed twice. During the lob-tails, it became apparent that the whale was tangled in a considerable amount of gill net gear (both polypropylene "lead" line with its embedded floats and thinner gill net mesh attached to the lead line). It was unable to fully straighten its caudal peduncle because of the constraints of the gear. Between two and four minutes after surfacing, the whale again thrashed and trumpeted repeatedly. Four minutes into the surfacing, the whale started to open its mouth and shake its head vigorously from side to side. At this point we saw that the fishing gear also went through its mouth, essentially "bridling" the animal, leading into at least two full wraps of the line and mesh around its body. The mouth-open, head-shaking behavior was repeated seven times in the four minutes following the first display of the behavior, then not repeated until an hour later.

While the mouth-open head shaking continued for only a few minutes, the animal thrashed extensively for 34 min after surfacing. The effect of this was a continual shifting of the lines around the animal. It succeeded in freeing its tail stock but ended up with the wrapped gear farther forward on its back. A blue lead line float was now visible in the midline of the back halfway between the dorsal fin and blowholes. While not confirmed, we also believe that one, if not both, flippers were pinned to the body, as they were not observed to move from the side of the body throughout the observation (something we normally see in the course of humpback whale swimming). Gear trailed at least 15 m behind the animal on both sides, at which point we could no longer see the lead line due to lack of water clarity. The animal also continued trumpeting frequently; of the 107 respirations in the 34 min following the initial surfacing, 86.9% (93) were trumpets.

After 34 min the animal appeared to calm and entered a placid state for 12 min. While trumpets were still common, they represented only 47.8% (11 of 23) of the respirations during that period. From 46 to 81 min following surfacing, the whale would remain placid for 60–120 sec, then thrash for 15–20 sec. Trumpets were frequent, and the mouth-open head shaking again became common (being displayed 21 times in the last 11 min). At the 81-min mark, we terminated the observation due to loss of daylight with the whale continuing this activity. During the first 70 min the whale did not show any significant vector movement; in the last ten min it started moving south at an estimated speed of 0.5–1 knot. The animal never dove following its entanglement.

The whale was alone for the great majority of the observation. During the first 20 min after its entanglement, the concentration of whales in the area dispersed significantly. At the 33-min mark, three humpback whales (file animals Clipper, female, estimated birth in 1981; Alphorn, male, born 1983; and Ember, male, born 1982) rapidly approached the entangled animal. For the next 20 min they remained within 100 m of the stricken animal when they surfaced, although their surface time was minimal. All three animals

were obviously excited, trumpeting consistently and swimming rapidly at the surface.

We believe that the whale entangled in an actively fishing gill net rather than in ghost gear. There was a gill net marker within 100 m of the whale when it dove prior to resurfacing with the gear. Since the marker was visible after the surfacing but did not noticeably move during the incident, we believe the whale tore a portion of the net free. Prior to the entanglement, we saw no fishing gear on the animal, and its behavior was similar to that of other whales in the area. We believe that the whale went into the gear while subsurface feeding, since the netting clearly ran through the mouth and was apparently lodged in its baleen. Such subsurface and near-bottom feeding is not unusual for juvenile whales on Stellwagen Bank (Hain *et al.* 1995).

The thrashing response of the entangled animal, while potentially an instinctive response to the contact, was ineffectual. The whale succeeded in freeing its tail flukes and caudal peduncle to allow full movement but also appeared to further entangle its body. The initial thrashing response is similar to that documented in a California sea lion (*Zalophus californius*, Feldkamp 1985) and harbor porpoises (*Phocoena phocoena*, Kastelein *et al.* 1995), which was equally ineffectual. The response also bears some resemblance to an extreme response to biopsy darting described by Weinrich *et al.* (1992). In that case the animal responded initially by trumpeting, charging, and thrashing but appeared to exhaust itself and entered a placid resting state shortly thereafter. Both the overall number and frequency of trumpets indicate that the animal was extremely disturbed or agitated, as trumpets are thought to be indicative of a disturbance or a stress response (Watkins and Wartzok 1985, Weinrich *et al.* 1992).

While we were not able to record any subsurface acoustic signals, it is possible that the entangled animal was vocalizing extensively, resulting in the approach of the other three humpbacks. If nothing else, the trumpet blows that we heard have an underwater acoustic component (Watkins 1967), and unusually extensive subsurface vocalizations, especially moans, have been recorded from other entangled humpback whales (Winn *et al.* 1979). Similar conspecific approaches were also seen in those cases. The approach of conspecifics to calls of non-entangled whales recorded on their feeding grounds has been documented previously (Mobley *et al.* 1988). However, we saw nothing which would indicate helping or care-giving behavior on the part of the other whales, which left the area after approximately 20 min.

While we do not know conclusively whether the whale survived its entanglement, we have not resighted the whale since that day. Spring is a time when many rarely sighted and perhaps migratory whales are photographed (unpublished data), and whale # 603 had only been seen twice before in the area (including a sighting the day before it entangled).

ACKNOWLEDGMENTS

I would like to thank Heidi Iken and Ken Smith, who helped collect the sequential behavioral data in the field. Andy Dizon, John Heyning, and David Morin made

constructive comments on the manuscript. Many discussions with members of the Atlantic Large Whale Take Reduction Team during fall 1996 and winter 1997 led to revisiting this observation.

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A shift in distribution of humpback whales, *Megaptera novaeangliae*, in response to prey in the southern Gulf of Maine

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Abstract.—From the mid-1970's to the mid-80's, Stellwagen Bank was an important humpback whale feeding area with sand lance (*Ammodytes* spp.) as the major prey. Between 1988 and 1994, however, the number of humpback whales we identified each year on Stellwagen declined from a high of 258 (1990) to 7 (1994), and the mean number of whales identified per day fell from 17.7 (1988) to 0.9 (1994). Adult whales decreased steadily after 1988; juveniles decreased rapidly after 1991. Echo-sounder data from Stellwagen showed that prey trace levels declined from 19.1% of the vertical water column in 1990 to 2.8% in 1992 (no readings were taken in 1988–89, or 1993–94). Simultaneously, the number of whales identified on Jeffreys Ledge, north of Stellwagen Bank, increased dramatically beginning in 1992. Sixty-four percent of the whales identified on Jeffreys in 1992–94 were seen on Stellwagen Bank in 1988 and 1989. We hypothesize that humpback whales shift their distribution in order to prey upon recovering herring populations, their primary source of food.

Manuscript accepted 21 April 1997.
Fishery Bulletin 95:826–836 (1997).

Humpback whales, *Megaptera novaeangliae*, migrate seasonally between low-latitude breeding grounds and high-latitude feeding areas (Kellogg, 1929; Mackintosh, 1965; Katona, 1986). In the western North Atlantic, whales that winter in Caribbean waters migrate to feeding grounds in New England (the Gulf of Maine), in the Gulf of St. Lawrence, and in waters off Newfoundland, Greenland, Iceland, and Norway (Katona and Beard, 1990). The whales using each feeding area appear to consist of extended matrilines (Baker et al., 1990; Clapham et al., 1992). Within feeding areas, prey distribution has been a primary influence on the local distribution and micromovements of all baleen whales examined to date (Whitehead and Carscadden, 1985; Payne et al., 1986, 1990; Piatt et al., 1989).

Studies of humpback whale movement, ecology, demography, behavior, and social organization on their feeding grounds in the Gulf of Maine have been ongoing since the mid-1970's, (Payne et al., 1986; Clapham and Mayo, 1987, 1990; Weinrich, 1991; Weinrich and Kuhlberg, 1991; Clapham et al., 1992; Weinrich et al., 1992; Katona et al.[1]). During this period, several shifts in the distribution of humpback whales have been reported. Payne et al. (1986) showed that humpback whales in the late 1970's had moved from primary abundance on Georges Bank and in the waters of the northern Gulf of Maine to the inshore southwestern Gulf of Maine, especially Stellwagen Bank and the Great South Channel. They attributed this shift to a fishery-induced collapse of herring (*Clupea harengus*) populations (Anthony and Waring, 1980; Grosslein et al., 1980) and a corresponding increase in sand lance (*Ammodytes* spp.) (Meyer et al., 1979; Sherman et al., 1981, 1988; Sherman 1986; Sissenwine 1986). Both species are known prey for humpback whales (Mitchell, 1973; Overholtz and Nicholas, 1979; Kawamura, 1980). These fish species are potential ecological competitors (Reay, 1970; Meyer et al., 1979; Sherman et al., 1981); moreover, herring are known predators of

[1] Katona, S. K., P. Harcourt, J. S. Perkins, and S. D. Kraus. 1980. Humpback whales: a catalog of individuals identified by fluke photographs. College of the Atlantic, Bar Harbor, ME, var. pagination.

sand lance (Fogarty et al., 1991). Sightings of humpback whales off the Maine coast, where herring were the primary whale prey, decreased dramatically during the late 1970's (Payne et al., 1986; Mullane and Rivers[2]). Sand lance frequently use shallow areas with sandy bottoms, such as Stellwagen Bank in the southern Gulf of Maine (Meyer et al., 1979). This shift in distribution, and corresponding change in primary prey type, may have also led to changes in feeding behavior (Weinrich et al., 1992). Humpback whales remained abundant in the southwestern Gulf of Maine throughout the 1980's, with a brief decrease in some areas during 1986–87 (Payne et al., 1990; Cetacean Res. Unit[3]).

We documented a gradual but continuous decrease in the use of Stellwagen Bank by humpback whales during 1988–94. Our data suggest that whales have returned to a distribution similar to that documented until the late 1970's. We hypothesize that this return is due to the recovery of herring stocks in the Gulf of Maine and to a corresponding decrease in available prey for humpback whales on Stellwagen Bank and in other areas favored by sand lance in the southwestern Gulf of Maine.

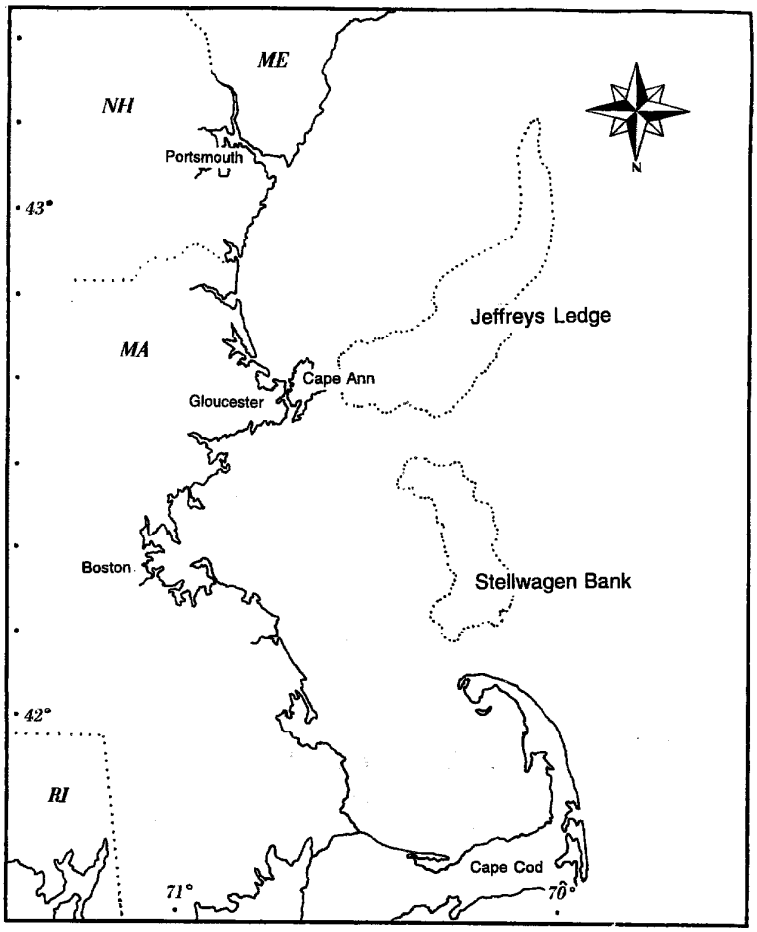

Figure 1
The study area in the Gulf of Maine.

Methods

Survey methods

From 1 May to 30 October, 1988 to 1994, daily shipboard surveys were carried out aboard commercial whale-watching boats. These departed from Gloucester and Boston, Massachusetts, and were typically 4–5 hours in duration. There were usually two cruises per vessel per day. A typical cruise included 90–120 minutes in areas where whales were often observed, as well as 2–3 hours of transit time. Whale watches usually emphasized the northern half of Stellwagen Bank. On occasion, whale watches surveyed the southern half of Jeffreys Ledge to the northeast of Cape Ann (Fig. 1). This effort is detailed in Table 1. Within each whale-watching trip, protocol and typical amount of observation time were consistent on all vessels.

Whale-watching cruises were supplemented by occasional day-long (7–13 h) excursions on research vessels. These took place 1 April to 15 November of each year, with emphasis on April and October–November, as well as during periods of significant whale concentration from May to September. During each cruise, a specific attempt was made to conduct a comprehensive photo-identification survey of a specific area (i.e. northern Stellwagen Bank, southern Jeffreys Ledge, etc.). As time allowed, coverage was devoted to a larger portion of the entire geographic feature (either Stellwagen Bank or Jeffreys Ledge). Specific areas were determined by recent sightings of whale aggregations, reliable reports of whale sightings from local boaters, or a determination that an area had not been recently surveyed. Jeffreys

[2] Mullane, S. J., and A. Rivers. 1982. Mt. Desert Rock, Maine. Annual Report, 27 p. [Available from Allied Whale, College of the Atlantic, Bar Harbor, ME.]

[3] Cetacean Research Unit. 1980–89. Cetacean Research Unit, PO Box 159, Gloucester MA 01930. Unpubl. data.

Table 1

Study effort by both number of survey days and number of survey trips for both Stellwagen Bank and Jeffreys Ledge. "JLSN days" represent the total number of survey days represented by the Jeffreys Ledge Sighting Network (JLSN), established after the 1992 season (see text for further details).

Year	Stellwagen days	Stellwagen trips	Jeffreys days	Jeffreys trips	JLSN days
1988	145	558	16	44	0
1989	151	550	17	20	0
1990	166	516	32	37	0
1991	160	460	31	36	0
1992	171	506	34	37	69
1993	106	364	48	79	119
1994	86	141	86	141	138

Ledge was the destination for just under half of the dedicated cruises from 1988 to 1992, all but four in 1993, and all but two in 1994.

Beginning in 1990, sighting and photo-identification data were also collected from a whale-watching boat operating out of Kennebunk, Maine, to obtain information from the northern end of Jeffreys Ledge. Observer coverage was for one trip per day, 3–5 days per week. Because of the unusually large number of whales first observed on our dedicated cruises to Jeffreys Ledge in 1992, a photo-identification network (consisting of three whale-watching boats working on Jeffreys Ledge for one trip per day) was formalized in fall 1992 (after the completion of field efforts), and existing 1992 data were obtained. Beginning in 1993, data collection from these vessels was standardized to be directly comparable with Stellwagen Bank whale-watching data. Because 1993 represented the first year in which Jeffreys Ledge data were collected in any kind of standardized fashion, occurrence and occupancy (defined below) were not calculated for Jeffreys Ledge humpback whale sightings.

Study areas

Stellwagen Bank, now a National Marine Sanctuary, is a sandy glacial deposit approximately 32 km long with depths from 18 to 37 m (Fig. 1). It borders the eastern margin of Massachusetts Bay and is located approximately halfway between Cape Ann and Cape Cod, Massachusetts. Jeffreys Ledge is a more complex, winding, shallow ledge, with typical depths of 45 to 61 m and with a length of approximately 54 km. Its substrate is a mixture of rocky and muddy bottoms. The southern edge of Jeffreys Ledge is 9 km northeast of Rockport, Massachusetts, whereas the northern end lies 36 km east of York, Maine. Stellwagen Bank and Jeffreys Ledge are separated by 21.6 km at their closest point.

Field methods

Individual humpback whales were identified from photographs of distinctive pigment patterns on the ventral surface of their tail flukes or from the shape of and scarring on the dorsal fin (or by both features) (Katona and Whitehead, 1981). Two observers collected data on each whale or group of whales. One observer was responsible for photographing each whale, while the second recorded the whale's location (by means of LORAN-C), group affiliations, and behavior. This observer also recorded which photographs were taken of each whale, as dictated by the photographer. Each group of whales in an area was usually observed for 1–30 minutes; most, if not all, whales in a single location (3–5 km radius) were identified during each observation period. Field methods were consistent on all vessels.

Age class and sex determination

Individuals were identified by comparing photographs with those of a catalog of humpback whales maintained at the Cetacean Research Unit (CRU), Gloucester, MA. Details on cataloging methods and contents of the catalog were given in Weinrich (1991), Weinrich and Kuhlberg (1991), and Weinrich et al. (1992) and are based on procedures outlined by Katona and Whitehead (1981). Whales were sexed by photographing them while belly up at the surface (and by noting the presence or absence of a small lobe immediately posterior to the genital slit [Glockner, 1983]), by observing a female with calf, or by using molecular techniques (Baker et al., 1991). Individuals were assigned to age classes (juvenile or adult) based on known age (first observation as a calf) or based on the consensus among all experienced CRU observers of an animal's relative size at first sighting. The accuracy of the latter technique was confirmed by estimating the age class of animals of unknown identity in the field and by finding that these estimates matched (photographically) animals of known age. No incorrect classifications were made (n=51). For the purposes of this paper, an animal was classified as an adult if it was known to be at least five years old, an age at which 50% or more of the population is mature (Chittleborough, 1965; Clapham and Mayo, 1990).

Prey density

In 1990–92, a SITEX HE-358 50-kHz echo-sounder and chart recorder aboard a whale-watching vessel

were used to record prey density on Stellwagen Bank in the immediate area where whales had been observed. The echo-sounder was used for 83 days during 1990 (9 May to 20 October; 153 total hours), 98 days during 1991 (9 May to 28 September; 221 total hours), and 69 days during 1992 (24 April to 24 October; 60 total hours). Clear readings throughout the water column (i.e. with no interference present) were obtained for 69 hours in 1990, 166 hours in 1991, and 60 hours in 1992. An echo-sounder operating at this frequency is likely to detect the presence of fish but unlikely to detect plankton unless it is present in extreme densities (Dolphin[4]). The echo-sounder was started as the boat slowed to begin whale observations and turned off when the vessel left the observation area to return to port. Because echo-sounder tracings were obscured by noise when the vessel was moving at cruising speed (e.g. moving from one group of whales to the next), tracings performed at cruising speed were eliminated from analysis. A timing mark was placed simultaneously on both the echo-sounder chart and the data sheets by the second observer at 10-min intervals.

The echo-sounder chart was later sampled at 2-min intervals by interpolating between the 10-min marks. For each sampling point, prey presence was scored visually in 3.3 m (10 ft) vertical increments from the surface to the bottom, with a sliding score of zero (for no prey) to 10 (prey throughout that 3.3 m interval). From these readings mean values for vertical bait density were calculated for each quarter of the water column and the total water column. Mean depth in which readings were taken was 38.4 m (SD=15.1 m). No echo-sounder data were recorded on Jeffreys Ledge.

Although such data give an idea of the availability of prey in the immediate vicinity of whales, they do not reflect an area where whales were not present. Hence, there could have been very similar or different prey concentrations very nearby, without that information ever being recorded. However, since each year's data set came from numerous days and contained data points from several different locations (albeit within a 3–4 mile radius) within each day's observations, we feel they at least give a crude overview to overall prey densities in the vicinity of whales.

Data management and analysis

Both daily whale sighting data and prey density data were stored in PC-based computer files and analyzed with commercially available statistical software (SPSS/PC+, Kinnear and Gray, 1992). For daily sighting data, an Xbase program was written to isolate the sightings of each whale and to calculate statistics summarizing that individual's within-year sighting history (including occurrence and occupancy—see below) in each part of the study area. These values were then stored in a separate data file and analyzed with the same statistical software. Temporal trends were analyzed with least-squares regression (Snedecor and Cochran, 1967) of individual data points with the year of observation as the independent variable, although only annual means are presented in our tables for occurrence and occupancy scores. The slope of the regression line (B) and the probability value (P) from a test of the null hypothesis that the slope did not differ from zero are presented for each test. Calves were eliminated from these analyses because we assumed that a calf is merely following the mother in her choice of habitat.

Definitions

"Occurrence" is defined as the number of days on which an individual whale was photographed in a single year. "Occupancy" is the number of days elapsed from the first to the last recorded sighting of an individual whale within a year. These definitions are consistent with those used by Clapham et al. (1992).

Results

Stellwagen Bank

Total number of humpback whales identified per year The number of humpback whales identified in any single year on Stellwagen Bank ranged from 258 (1990) to a low of 7 (1994), with a mean of 153.6 (SD=88.4) (Fig. 2). These values show a statistically significant declining trend (B=–32.82, P=0.033).

When the total number of whales was broken into age class, differences in annual trends were apparent. Numbers of adult whales identified on Stellwagen ranged from 173 (1990) to 3 (1994; mean= 102.8, SD=60.4). These values also showed a statistically significant declining trend (B=–0.84, P=0.018). Number of juveniles identified in each year varied from 85 (1990) to 4 (1994; mean=50.71, SD=29.2). These also showed a downward trend, although not statistically significant (B=–23.50, P=0.099). The ratio of identified adult whales to identified juveniles varied from 2.5:1 (in 1988) to 0.75:1 (in 1994). Numbers of cow-calf pairs throughout the study period

[4] Dolphin, W. F. 1994. Department of Biomechanical Engineering, Boston University, Boston, MA 02215. Personal commun.

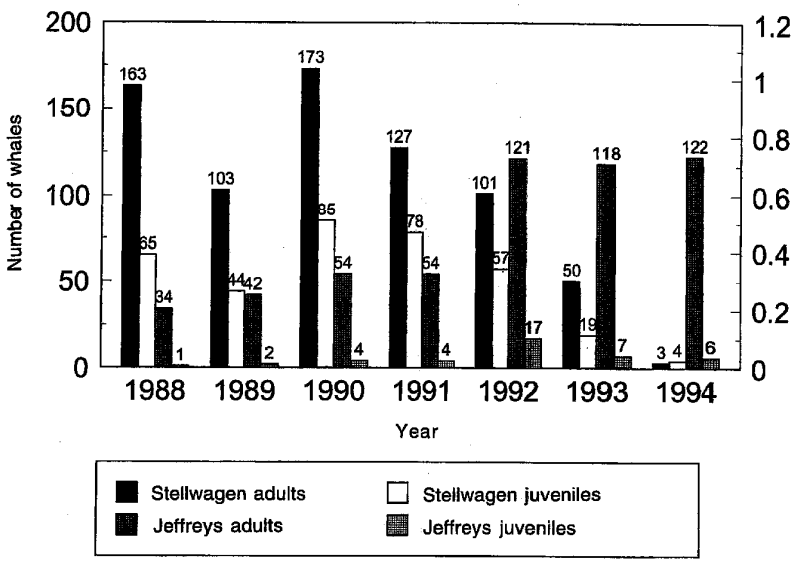

Figure 2

The number of individual humpback whale adults and juveniles identified per year on Stellwagen Bank and Jeffreys Ledge, 1988–94. Note the rapid annual decrease of adults on Stellwagen Bank starting in 1991, and the corresponding increase on Jeffreys Ledge beginning in 1992. Juveniles started a rapid decrease on Stellwagen Bank in 1992.

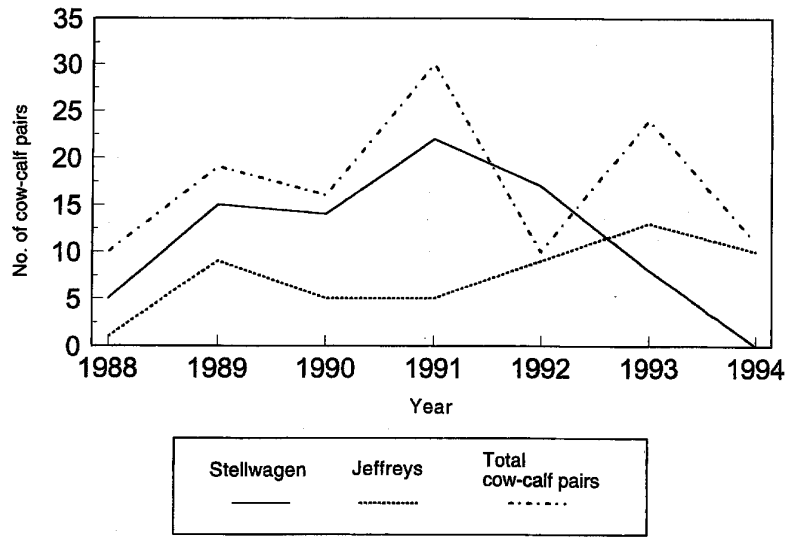

Figure 3

The number of cow-calf pairs on Stellwagen Bank, Jeffreys Ledge, and in the entire Gulf of Maine, 1988–94. The percentage of known mother-calf pairs that were sighted on Stellwagen began to decrease dramatically in 1992, the same year that the percentage mother-calf pairs began to increase on Jeffreys Ledge.

showed no significant trend in the absolute number seen on Stellwagen (B=–1.214, P= 0.424). Numbers of cows and calves began in 1991 to decline sharply, especially when compared with the total number of cow-calf pairs in the Gulf of Maine. By the last year of the study no cow-calf pairs were seen (Fig. 3).

Occurrence and occupancy

Mean occurrence of humpback whales on Stellwagen Bank within a single season ranged from 13.1 days (1989, n=147) to 6.6 days (1993, n=69) (Table 2; B=–0.30, P=0.501). Adults showed a within-year mean occurrence of 6.4 days (SD=4.8, n=720), with a statistically significant declining trend through the study period (B=–1.98, P<0.001). Compared with adults, juveniles showed a higher mean within-year occurrence (mean= 14.5 days, SD = 4.2, n=352), which significantly increased throughout the study period (B=1.63, P=0.030).

Occupancy of individual whales within years declined significantly from a mean of 61.8 days (1989, n=147) to 21.6 days (1994, n=7) (Table 3; B=–7.07, P=0.002). Again, age classes showed different trends. Adults had a mean occupancy period of 39.3 days (SD = 23.56, n=720) throughout the study period, with a significant declining trend (B=–10.65, P<0.001). In contrast, juveniles had a mean occupancy period of 55.0 days (SD=13.21, n=352), with no significant trend apparent (B=–2.82, P=0.296).

Although juveniles showed no significant trend in occupancy and had occurrence values that actually increased throughout the period, a comparison of median values for

Table 2
The mean occurrence (in days) of humpback whales on Stellwagen Bank, 1988–94.

Year	Adults	Juveniles	Combined total
1988	13.5	7.2	11.2
1989	12.2	15.2	13.1
1990	7.9	12.5	9.6
1991	6.2	17.0	10.7
1992	7.2	19.6	12.0
1993	3.1	15.7	6.6
1994	1.3	19.8	11.9

Table 3
The mean occupancy (in days) of humpback whales on Stellwagen Bank, 1988–94.

Year	Adults	Juveniles	Combined total
1988	67.9	47.1	60.4
1989	56.5	71.6	61.8
1990	52.3	55.0	51.8
1991	47.5	73.1	54.6
1992	32.4	53.3	42.2
1993	17.2	48.4	25.7
1994	1.3	36.8	21.6

each of these variables portrays a trend more similar to that seen from adults. From 1992 through 1994, prolonged residency of a few juveniles skewed occurrence and occupancy values. During 1991–93, median occurrence of juveniles fell from seven days to three, whereas median occupancy periods fell sharply, from 59.5 days to 15 days. In 1994, so few juveniles were seen (four) that the relatively high values of two individuals severely skewed the results for that year. Median values of adult occurrence and occupancy showed the same trends as those portrayed from the regression analyses.

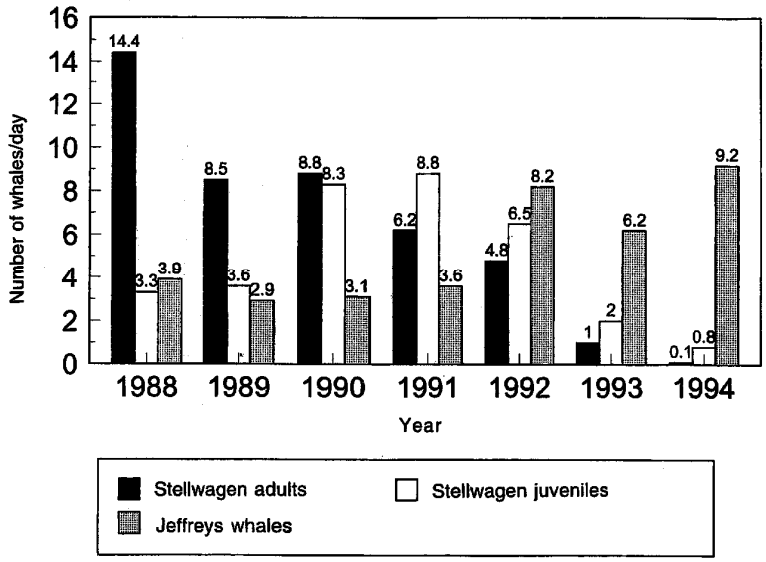

Figure 4
The mean number of whales identified per day in each age class and year on Stellwagen Bank and Jeffreys Ledge, 1988–94. Jeffreys Ledge juveniles were not included because of their low numbers. Note the rapid decrease among adults on Stellwagen Bank beginning after 1988, and the decrease among juveniles on Stellwagen beginning in 1992. Jeffreys Ledge values were highest in the final three years, after the general decrease on Stellwagen Bank.

Number of whales per day

One of the clearest indicators of habitat use is the number of identified humpback whales sighted on Stellwagen Bank each day. This measure incorporates two of the above components—the number of whales identified as well as how often they were sighted in the area. Throughout the study period, a mean of 12.7 (SD=11.31, n=1,072) whales were identified per day, ranging from an annual high of 17.7 (SD= 15.30, n=153 days) in 1988 to a low of 0.9 (SD=0.76, n=97 days) in 1994 (Fig. 4). Adults and juveniles again showed different trends. Adults per day declined steadily from 14.4 in 1988 to 0.1 in 1994 (B=–2.21, P<0.001), whereas juveniles showed no clear trend, with a high of 8.8 in 1991 and a low of 0.8 in 1994 (B=–0.44, P=0.501). Juvenile values showed a clear peak in 1990–91 as compared with other years (Fig. 4).

Vertical prey density Mean overall vertical prey density decreased from 19.1% with prey traces in 1990 to 2.8% with prey traces in 1992 (B=–0.38, P<0.001) (Table 4). Similar significant decreases were seen in each vertical quarter of the water column (Table 4).

Although it was impossible to determine prey type from traces alone, catches of groundfish (mainly Atlantic cod [*Gadus morhua*] and haddock [*Melanogrammus aeglefinus*]), and bluefish (*Pomatomus saltatrix*) in the immediate area of trace recordings

Table 4
Percentage of the water column with echo-sounder prey traces by year in each quarter. Mean depth was 38.4 meters.

	Quarter of the water column				
Year	Top 25%	2nd 25%	3rd 25%	4th 25%	Total
1990	17.2%	15.0%	16.8%	24.3%	19.1%
1991	3.1%	4.5%	7.3%	12.7%	7.9%
1992	1.4%	0.3%	0.8%	1.1%	2.8%

by party-fishing boats indicated that sand lance were the predominant fish prey in stomach contents of humpback whales; some small mackerel (*Scomber scombrus*) and herring were also observed in stomachs in much lower frequencies. Herring were more prominent in October during each field season, when only a small number of echo-sounder data points were recorded.

Jeffreys Ledge

Total number of humpback whales identified The number of humpback whales we identified on Jeffreys Ledge increased from a low of 35 (in 1988) to a high of 138 (in 1992) (B=19.57, P=0.004; Fig. 2). Although there was a generally increasing trend, there was a sudden increase from 58 in 1991 to 138 in 1992.

The increase among adult whales also showed a significant increase across years (B=17.25, P=0.003). Although juveniles increased steadily throughout the period, and suddenly from 1991 to 1992, they did not do so at a significant rate (B=1.357, P=0.201). (The same analysis without 1992 data, where there were an unusually high number of juveniles, does show a statistically significant increasing trend among juveniles [B=0.914, P=0.006]). Cow-calf pairs also showed a significantly increasing trend (B=1.429, P=0.049).

In each year, identified humpback whales on Jeffreys Ledge were biased toward adults. No more than 17 juveniles were photographed on Jeffreys Ledge in any year, and the number of juveniles photographed exceeded 10 in only a single season (1992). The ratio of adult to juvenile whales ranged from a high of 34.0:1 in 1988 to 7.1:1 in 1992, higher in all cases than the adult:juvenile ratios on Stellwagen Bank.

Number of whales per day The mean number of whales per day ranged from a low of 2.9 (SD=1.9, n=22) in 1989 to a high of 9.2 (SD=7.7, n=138) in 1994 (Fig. 4; B=0.98, P=0.022). In 1993 and 1994, the only years with coverage comparable to Stellwagen Bank levels, means of 6.2 (SD=6.9, n=116) and 9.2 (SD=7.7, n=138) whales were identified on each day of coverage, respectively.

The pattern of humpback abundance on Jeffreys Ledge showed surprising seasonal consistency throughout the study. Sightings were sporadic during May, June, and early July, with few, if any, concentrations of whales observed. In all years, concentrations increased from late July through September, with whales still abundant in three of the seven Octobers observed (1988, 1989, 1993).

Identification comparison To determine whether the whales using Jeffreys Ledge were the same as those previously inhabiting Stellwagen Bank, we examined how many of the 210 humpback whales identified on Jeffreys Ledge in 1992–94 had been previously sighted on Stellwagen Bank. Of this group, 123 (58.5%) were photographed on Stellwagen Bank during 1988–89. When the 17 animals that had not yet been born in 1988–89 were also discounted from the Jeffreys population, 63.7% of all animals were found to have been seen previously on Stellwagen. By comparison, only 35 (16.6%) of the Jeffreys Ledge whales were also seen on Stellwagen Bank during the 1992–93 period, or 16.6% of the total Jeffreys Ledge population.

Discussion

Humpback whales, especially adult and cow-calf pairs, decreased their use of Stellwagen Bank drastically between 1988 and 1994. The decreased use is reflected in decreased numbers of whales identified, decreased numbers of whales (regardless of age class) per day, and decreased adult occurrence and occupancy. The decline led to a virtual abandonment in 1994, when only seven humpback whales were seen on Stellwagen, and only two of those had occupancy periods longer than ten days. The decline in whale use corresponds with a decline in the amount of echo-sounder prey traces at the sites on Stellwagen Bank where whales were found over three years during the study. Although adults showed a clear decreasing trend on Stellwagen Bank, juvenile whales showed a less clear pattern. However, even juveniles showed a rapid decrease in use from 1991 to 1994.

The increase in juvenile whales on Stellwagen Bank during 1990–91 while adult use decreased may also be a more subtle indicator of a shift in habitat quality. Previous work has shown that juvenile humpback whales are often found in areas where prey density is lower than in areas where adults predominate (Weinrich and Kuhlberg, 1991; Belt et al.[5]), and may, therefore, be considered suboptimal

habitat for the species. The vertical distribution of prey has also been reported to be different between concentration areas of the two age classes. Adults are found where prey is concentrated in the upper reaches of the water column (Belt et al.[5]) where a humpback whale's bubble and cooperative feeding strategies are most effective (Hain et al., 1982; D'Vincent et al., 1985; Weinrich et al., 1992; Weinrich et al.[6]) or where foraging is most efficient because energy expenditures associated with diving are lowest (Dolphin, 1987). Juveniles appear to concentrate more often in areas where prey are predominantly subsurface, often feeding on or near the sea floor (Swingle et al., 1993; Hain et al., 1995; Belt et al[5]; Weinrich et al.[6]). In the years where juvenile use increased while adult use decreased (1990–91), echosounder data showed that prey were most concentrated in the bottom 25% of the water column. Even within the year 1990, prey traces were found to be more common in the upper portions of the water column on days when more adult whales than juveniles were present (Belt et al.[5]).

These findings suggest that there are multiple ways of assessing habitat quality for whales. Past reports of population trends have included only the number of whales sighted per unit of effort as a guide to habitat quality (Payne et al., 1986, 1990; Piatt et al., 1989). However, indicators such as independent trends in occurrence and occupancy of individual whales, the number of individuals identified over a given time period, and even the age class of individuals, may also be important indicators of habitat quality. Although all of these measures (except the last) are factors of sightings per unit of effort, these individual components may be illuminating in detailed studies of a particular area. Prey type, for instance, could influence factors such as occurrence or occupancy (or both). In this case, a relatively nonmigratory prey species, such as sand lance (which are tied to areas of particular bottom substrate and topography) could lead to residency extremes (with whales staying in an area for prolonged periods or avoiding the area altogether), while a less habitat-restricted prey (such as herring) could lead to highly variable intraseason distribution patterns.

Although the number of whales on Stellwagen Bank showed a dramatic decrease, the number of whales photographed on Jeffreys Ledge more than doubled in the last three years of the study. The corresponding increase in observer effort during the same period no doubt had some effect on the dramatic increase in both the number of identified individuals and the mean number of whales identified per day. However, existing opportunistic data were collected following the 1992 season because of the increased use of the area suggested from our dedicated vessel surveys, where methods remained standard across years. Further, captains of whale watching boats and naturalists who had worked on Jeffreys Ledge since the mid-1980's unanimously agreed that there was a sudden, dramatic increase in daily whale sightings beginning in 1992. Therefore, we fully believe that an increase in effort is not the sole, or even the primary, cause for any increase in humpback whale numbers reported beginning in 1992.

Our data show that the sudden increase in humpback whale abundance on Jeffreys Ledge was primarily the result of whales seen on Stellwagen Bank earlier in the study relocating for much or all of their summer feeding season. What is perhaps more surprising is the relatively small number of whales that appeared in both areas during 1992 and 1993, despite the relative nearness of these areas to each other. Most of those whales photographed in both areas were seen on Stellwagen Bank for a brief period in October 1993, when herring stocks are known to migrate through the area (Fogarty and Clark[7]).

The consistent timing of whale aggregations on Jeffreys Ledge in each year (starting in early summer) corresponds with both the major influx of herring onto the Ledge and the start of their spawning season (USDC, 1991; Fogarty and Clark[7]). The biomass of the Georges Bank herring population (of which this is a segment—Stephenson and Kornfeld, 1990; Fogarty and Clark[7]) has increased dramatically over the past decade and, by 1991, was comparable to that of its pre-exploitation size (Stephenson and Kornfeld, 1990; Sherman, 1992; NMFS[8]). Echo-sounder data, observation of surface prey, and catches of local fishing boats all indicated that herring were common on Jeffreys Ledge at the same time and location as aggregations of

[5] Belt, C. R., M. T. Weinrich, and M. R. Schilling. 1991. Effects of prey density on humpback whale (*Megaptera novaeangliae*) distribution in the Southern Gulf of Maine. P. 6 *in* Abstracts of the 9th biennial conference on the biology of marine mammals. Society for Marine Mammalogy, Chicago, IL.

[6] Weinrich, M. T., C. R. Belt, M. R. Schilling, and M. E. Cappellino. 1985. Habitat use patterns as a function of age and reproductive status in humpback whales. Abstract *in* Abstracts of the 6th biennial conference on the biology of marine mammals. Society for Marine Mammalogy, Lawrence, KS.

[7] Fogarty, M. J., and S. H. Clark. 1983. Status of herring stocks in the Gulf of Maine region for 1983. Woods Hole Laboratory Reference Document 83-46, NMFS, NOAA, 33 p. [Available from Northeast Fisheries Center, Woods Hole, MA.]

[8] NMFS (National Marine Fisheries Service). 1992. Report of the thirteenth Northeast regional stock assessment workshop (13th SAW). Northeast Fisheries Science Center Document 92-02, Northeast Fisheries Center, NMFS/NOAA, Woods Hole MA. 71 p.

whales. The area is also a primary location for seine fishing for herring off New England. Herring seiners were observed fishing or transiting to or from areas of whale aggregation daily during summers 1992–94.

Although herring stocks were increasing, our data indicated that prey available for whales on Stellwagen showed a marked decrease, corresponding to a decrease in sand lance populations throughout the Northeast ecosystem (Sherman, 1992). This decrease in prey would be expected given the documented inverse relation between sand lance and herring or mackerel stocks, primarily due to direct predation (Fogarty et al., 1991). Although we cannot assign a definitive prey type to our echo-sounder traces from Stellwagen, the documented importance of sand lance as a prey for whales on Stellwagen Bank through observations of prey in the mouths of feeding whales (Hain et al., 1982; Weinrich et al., 1992), the direct observation of sand lance on Stellwagen Bank (Hain et al., 1995), prey in fish stomachs, and the lack of other suitable prey records throughout the years suggest that sand lance remained the predominant prey type for whales in that location.

We propose that humpback whales feeding in the Gulf of Maine ecosystem have shifted from their primary distribution of the mid-1970's through the late-1980's as a result of a shift in the abundance of available prey. Although we have considered only a small portion of the Gulf of Maine habitat, our findings correspond with other data from the same period. In the western side of the Great South Channel (an important area for whales from 1979 to 1991 where sand lance were the primary prey [Kenney and Winn, 1986; Payne et al., 1990]) humpback whale sightings were sporadic after July 1991 (Francis[9]; Clapham[10]; Mattila[11]). Off Mt. Desert Rock, Maine, where humpbacks were virtually absent throughout the 1980's, numbers of whale sightings increased to levels far above those of the mid-1970's (Fernald[12]). Surveys conducted in 1993 on Georges Bank by researchers from the YONAH (Years of the North Atlantic Humpback) project also sighted large numbers of humpbacks, including many animals photographed on Stellwagen Bank in previous years (Clapham[10]).

If a resurgence of herring is responsible for shifts in distribution and in primary prey type, it suggests that the distribution of humpback whales through the late 1970's and 1980's may have been a human-induced consequence. The "explosion" of sand lance in the mid- to late 1970's is thought to be primarily the result of the virtual elimination of herring due to overfishing. If this is true, we hypothesize that our observed distribution of whales from 1992 to 1994 should remain relatively stable over the course of a fairly long period because the current situation would be closer to a "natural" ecosystem.

Alternatively, fluctuations in primary prey may occur naturally, and may take place regardless of human interference. If this is true, we hypothesize that whale distributions will show fluctuations that may be cyclical. New England ground-fishermen have for years talked of regular cycles in sand lance abundance, although there are no scientific data to support this often-made contention.

Regardless of which hypothesis, if either, proves true, our data show a shift in both distribution and primary prey type for humpback whales in southern New England waters in recent years. Because this shift has been so complete, it will be interesting and illustrative to see whether, and how, other potentially prey-dependant humpback whale life history parameters, such as reproductive patterns, social behavior, and demographics of whales, all well-documented during a period of explosive sand lance abundance (Clapham and Mayo, 1990; Weinrich, 1991; Weinrich and Kuhlberg, 1991; Clapham et al., 1992), change in response to these ecosystem alterations.

[9] Francis, L. 1995. Atlantic Cetacean Research Center, PO Box 1413, Gloucester, MA 01930. Personal commun.
[10] Clapham, P. 1995. Smithsonian Institution, Washington, DC. Personal commun.
[11] Mattila, D. 1995. Center for Coastal Studies, PO Box 1036, Provincetown, MA 02657. Personal commun.
[12] Fernald, T. 1995. Allied Whale, College of the Atlantic, Bar Harbor, ME 04609. Personal commun.

Acknowledgments

We would like to thank Cindy Belt, Tina Laidlaw, Joy Lapseritis, Laine Gonzales, Nancy Miller, Liz Phinney, Leo Axtin, Karla Bristol, and many interns at the Cetacean Research Unit for their assistance in gathering sighting data for this study. Staff of the Center for Coastal Studies, Provincetown, MA, and the Atlantic Cetacean Research Center, Gloucester, MA, were generous in sharing data on ages and sightings of individuals, especially mother-calf pairs. Portions of this study were funded by the Bruce J. Anderson Foundation, the Sudbury Foundation, the Fund for Preservation of Wildlife and Natural Areas, the Norcross Wildlife Foundation, and the American Cetacean Society—Los Angeles Chapter. This work was conducted under Marine Mammal Research Permit no. 681.

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